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THE MANUFACTURER AND BUILDER.

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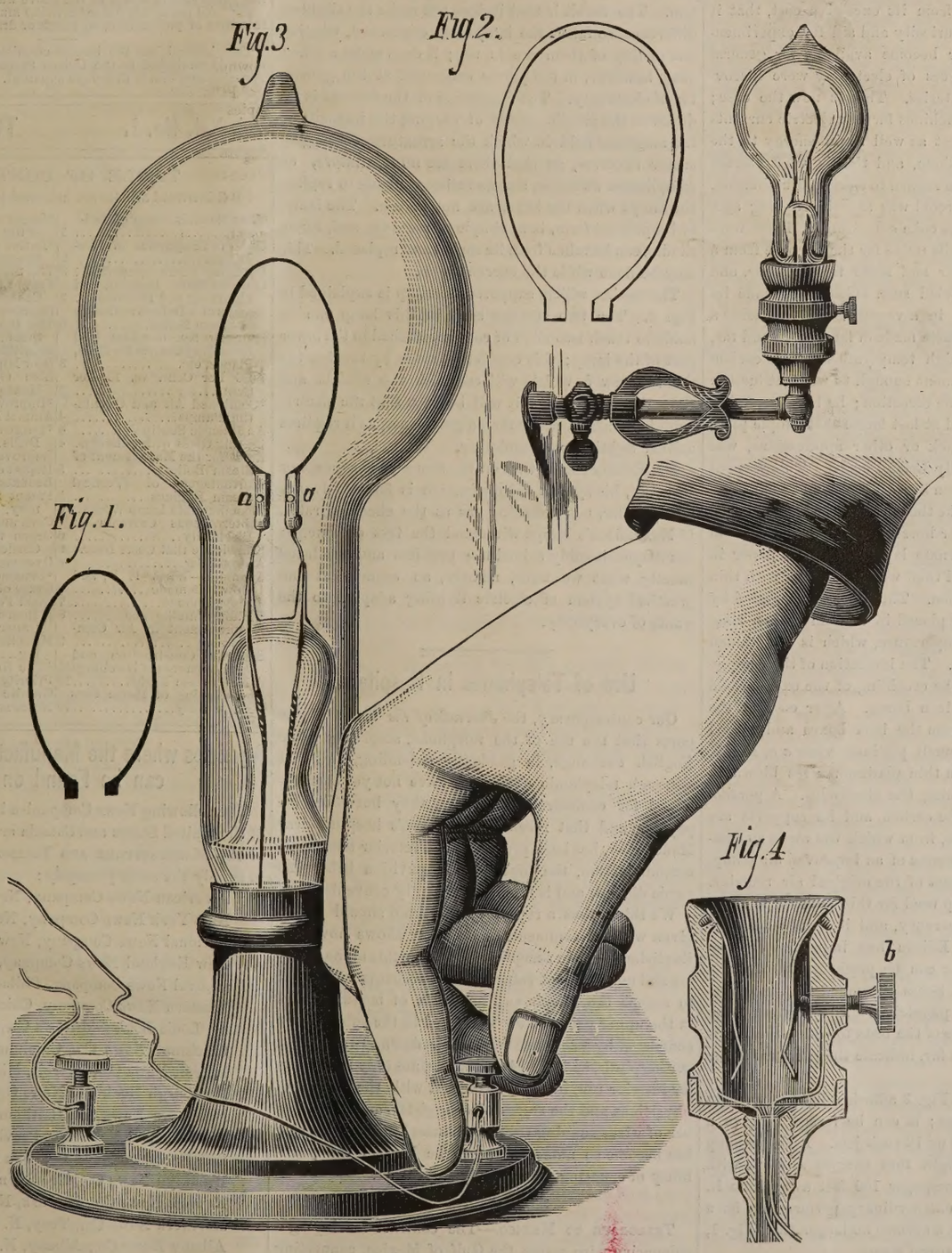
The Electric Lamp of Edison.

We take pleasure in representing on this page the form of lamp which Mr. Edison's researches have led him at last to adopt. It appears that he soon found that the electric arc, so called, (which is the intensely luminous spark that flashes through the air between two carbon points placed close together), does not satisfy the requirements, and this for several reasons: 1st. It is altogether too intense for domestic use. 2d. It is not adapted for subdivision, as proved by the many futile attempts to accomplish this. 3d. It is difficult to keep it steady, as proved by all the different devices applied to the electric lamps, with and without regulating clock-work, none of which thus far have fully met the requirements.

Mr. Edison discards these lamps altogether, and first used platinum, which he brought by the electric current to that state of incandescence in which it gives a light that, while strong enough for illumination, is at the same time not so intense as to produce a disagreeable glare, as is the case with the ordinary electric lights thus far used. But the use of platinum, or some platinum alloy, which he subsequently used, involves great expense, as it belongs to the rare metals; while the manufacture of millions of lamps, which will be needed to supply the demand when once the electric light is introduced, would certainly raise the price of that scarce and already too expensive material. Therefore, he published some time ago a request to miners, asking them to give attention to the finding of more platinum. This appeal resulted in showing that, if needed, more platinum would be forthcoming, as was proved by an exhibition of results made at the close of the recent meeting of the American Association for the Advancement of Science, at Saratoga, N. Y., where Prof. Forsyth Barker, of Philadelphia, explained a large number of samples, which showed that in this case the demand could be supplied, even if it increased very far above the present limits, which are very contracted, as this precious metal is not suitable for ornaments, being by no means a handsome looking metal, (which makes gold and silver so attractive); neither is it used for coin, although Russia introduced some such coin several years ago. It is only used for those scientific and manufacturing purposes where its place cannot be supplied by anything else, hence the limited demand never stimulated increased production.

Now, however, Mr. Edison discards the incandescent platinum altogether, and uses nothing but carbon, which certainly is cheap and abundant enough; but he places it in a vacuum in order to prevent its combustion, which certainly would follow in the air, and that very rapidly too, as at the temperature required to make substances emit light, the affinity of carbon for atmospheric oxy-



EDISON'S LATEST ELECTRIC LAMP.

gen is intensely strong—in fact, so strong that it surpasses all other affinities.

In this respect, he has returned to the first method employed by Sir Humphry Davy, who, in 1801, was the first to experiment with electric light. He used light wood charcoal, and in order to make it a better conductor, made it red-hot and plunged it into a bath of mercury, which penetrated into its pores and increased its conductivity. As he found that it rapidly burned up in the air, he placed this charcoal under a glass jar, from which the air was exhausted by an air pump. His light was as intensely strong as any of the present day, but then he used the Wollaston battery of the Royal Institute, consisting of 4,000 pairs of plates; with this battery, not being constant, the light lasted only about half an hour at its greatest intensity, and soon dwindled down. The later improvements in galvanic batteries, principally by Grove and Bunsen, enabled experimenters to keep the light up much longer—for hours at a time, and also reduced the cost of each light from about $100 to $10 or $20 an hour. It soon became evident, from its excessive cost, that it would remain a mere curiosity and aid for experimental research, but never become available for general use until cheaper sources of electricity were discovered than galvanic batteries. This is now the case; the dynamo-electric machines furnish electric currents nearly equivalent in cost as well as in energy to the steam that generates them, and this is what started the recent excitement in regard to electric illumination.

The use of wood charcoal was abandoned long ago, and pencils cut from gas coke substituted. These were soon displaced by pencils made for the purpose from a mixture of coal powder and some tarry matter, and then baked. Edison tried such substances, made incandescent and placed in a vacuum. He first tried a thread enveloped in a paste made of lampblack and tar, and carbonized at a high temperature. This carbon thread gave encouragement enough to warrant further investigation in the same direction; he tried a number of other substances, and at last found that simple plain paper, without lampblack or other applications, was the best of all, especially Bristol board. This was cut as shown in Fig. 2; when burned it becomes smaller, as seen in Fig. 1. To make the carbons, the Bristol board is stamped to the proper horseshoe shape by a die, and then placed with alternate layers of tissue paper in shallow iron boxes, and then weighted down with thin plates of ordinary carbon. Those boxes are closed by tight-fitting covers and placed in a muffle, when they are raised to a high temperature, which is maintained for a considerable time. The indication of the completion of the process is the crackling of the oxid formed on the exterior of the iron boxes. After cooling, the carbons are removed from the iron boxes and placed between the jaws of small platinum vises *a a*, Fig. 3, which are supported on thin platinum wires blown in the glass base and forming the electrodes. A portion of the glass base and the carbon and its supports are inclosed in a glass bulb, from which the air is so completely exhausted by means of an improved air pump, that only a millionth part of the original air remains. The improved air pump used for this purpose is operated by a current of mercury, and is named after its inventor, Sprengel. Edison has improved this so much, that high vacua can be produced in 25 minutes instead of the 45 hours consumed in the operation by some of our physicists. The vacuum is so nearly perfect that none of the tests to which the lamps have been subjected so far, indicate the presence of the slightest trace of air.

The lamp shown in Fig. 3 affords a light equivalent to a single 4-foot gas jet; it can be forced to give a light equal to that of 8 or 10 such jets. A single lamp of this kind gives a light that enables any one with good eyes to read a newspaper 100 feet away from it. This is certainly an extraordinary performance for a piece of carbon having a surface no larger than Fig. 1, which represents its natural size.

These paper carbons are very tough and flexible, and not liable to be broken or injured by jars; they may be nearly straightened before they will break. The carbon not only withstands rough mechanical usage, but is also proof against injury by the sudden turning on and off of the electric current. One of these carbons has been subjected to the severe test of applying and removing the electric current a number of times equivalent to 36 years of actual daily use, and yet the carbon appears to be not in the least impaired. It is clear that the horseshoe form of the carbon possesses a great advantage over the straight pencil or the luminous arc, the light being more diffused, and therefore softer and mellower, casting no sharp black shadows, nor giving such an intense light as to be painful to the eyes. The light resembles that of a gas jet, except in the matter of steadiness, the electric light being perfectly uniform and steady.

The lamps are so connected that the two wires leading from the electric generator run parallel to each other, and the lamps are placed between and connected with each wire, so that each lamp taps a part of the current, and so much of it as can go through its carbon. The result is that it does not make the slightest difference, so far as the lamps are concerned, whether one or fifty of them are in use; it does make a difference, however, in the power consumed at the generator of electricity. The regulation of the current is reduced to the simple matter of varying the intensity of the magnetic field in which the armature of the generator revolves, so that there are no regulators, no complicated switches, and no resistance coils to replace the lamps when the latter are not in use. The lamp, in its present form, is as simple as a candle, and, like a candle, can be taken from its socket and replaced. This may be done while the current is on.

The socket which supports the lamp is explained in Fig. 4. The two springs seen in this lamp can be made to touch two slips of copper attached to the lower part of the lamp; this contact is made by turning the thumb-screw *b*, which will establish the contact and start the lamp; thus it will be seen that the electric lamp is managed easier than a gas burner, as it requires neither lighting nor regulating.

Mr. Edison claims that on the score of cheapness or economy, his system of illumination is far in advance of any other, not excepting gas at the cheapest rates. If Mr. Edison's lamps withstand the test of time, he has unquestionably solved the problem and produced exactly what we want, namely, an economical and practical system of electric lighting adapted to the wants of everybody.

Use of Telephones in Hospitals.

Our contemporary, the *Journal of the Telegraph*, reports that the use of the telephone, according to an English exchange, is gradually extending, and that although telephonic exchanges have not yet been obtained for commercial purposes, they have become popular, and that recently a children's hospital, near Manchester, has been provided with interior telephonic communication, the most distant pavilion being 120 yards distant, and is found exceedingly convenient.

We think that a report of this kind should not be given without comment, as it clearly shows how slow Englishmen are in accepting improvements of the greatest and most evident value. Our merchants were quick to accept the telephone; hundreds of manufacturers in the upper part of New York, and in the suburbs, are connected by telephone with their down-town offices; our hospitals, and other institutions, not only have them for interior use, but are connected with the houses of physicians and the stores of druggists; and the number of wires running over the houses in New York city has become so numerous as to be beyond the possibility of counting, and is daily increasing.

TELEGRAPH TO MEXICO.—The contract for laying a submarine wire across the Gulf of Mexico, connecting the United States with the Mexican republic, has been approved by the Mexican Congress.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XII. No. 1. TWELFTH YEAR.

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Agencies where the Manufacturer and Builder can be Found on Sale.

The following News Companies in the principal cities of the United States and Canada are agents for the sale of the MANUFACTURER AND BUILDER, and are prepared to supply the same promptly:

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Publisher's Announcement.

With the present issue of this journal, the publisher begs to inform its wide circle of friends and patrons of a change in its editorial department. This change is made necessary by the retirement of Dr. Van der Weyde, who for a number of years has edited the Manufacturer and Builder ably and acceptably.

To the above announcement, the publisher wishes to add the further statement that he has secured for the future editorial conduct of the Manufacturer and Builder, the services of Dr. William H. Wahl, a gentleman widely and favorably known, both in the world of science and of journalism, and whose name will be a guarantee that the reputation and usefulness of this journal will be ably sustained.

Comparative Danger of Lightning and Railroads.

It will certainly surprise some readers when we state that as many, if not more, persons are yearly killed by lightning than there are passengers killed who travel on railroads. But it is a fact, proved by statistics, that in France, for instance, which is exemplary for the correctness of its statistics, (a result of the strong centralization of power to which that country was always subject), the number of persons killed by lightning is, for every ten years, about a thousand, or on an average nearly 100 per year; in some years 110 and 120 were killed, in other years 73. In other countries the statistics give similar results; in Switzerland, 10 per year; in England, 22; in Belgium, 3, on an average. But it should be remembered that these figures are a minimum, as in many instances the cause of death is not registered.

It follows from this that one out of every 400,000 persons is killed by lightning per year, while it has also been proved that if we take into account those struck and injured without being killed, the number is four times greater, or 1 in 100,000. Statistics also show that in large cities where people live in and between many high buildings, the chances of being struck are very small, but that in villages and in the country the danger is much greater, on account of the isolation of the houses. It is also proved that the greatest number of victims fall in mountainous regions; thus, for instance, in Switzerland the number of victims is more than three times as large as that in Belgium, while the population is smaller. In mountainous regions the danger is indeed great, as the cases mentioned as having happened in France are mostly confined to the mountainous Departments; thus the church at Chatoneuf-les-Moustiers, in the lower Alps, was struck on a Sunday during divine service, and 9 persons were killed outright and 82 seriously injured.

If this is compared with the statistics of accidents happening to railroad travellers, the results are very favorable for the railroads. It has, therefore, been often said that the safest place a man can be is in a car on a railroad train in full motion, and the cause of this comparative immunity from danger is the safety arrangements which bitter experience has taught to be necessary, and which have made railroad travelling so secure.

The moral we wish to draw from all this, is, that if accident insurance companies wish to send their agents in a field where their services are really needed, they ought to send them over the country; but they do not do this by any means, well knowing the small risk of travelling by railway, and the consequent small chance of having to pay damages for accidents. They almost entirely confine their agencies to the railroad offices, being well aware of the popular fear of railroad accidents, and in some offices solicit almost every traveller who buys a ticket to insure his life for $3,000 at the rate of 50 cents for 3 days, or $4.50 for a month. As $4.50 is the 666th part of $3,000, this rate suggests that, supposing the insurance company to make 100 per cent profit, that 1 of every 1,332 persons who travel are injured per month. But we have seen that the danger of being struck by lightning is much greater than that of meeting with an accident on a railroad, while the danger from lightning is only 1 in 100,000.

We leave the reader to draw his own conclusions, while we adhere to the opinion expressed on former occasions, that insuring one's life while travelling is only a voluntary tax paid by timid railroad travellers to enrich the stockholders of accident insurance companies and their agents, who enjoy liberal commissions.

Results of a Defective Design of Steam Boiler.

The Yorkshire Boiler Insurance and Steam Users' Co., of Bradford, England, has published an inquest held by the coroner there in the case of a boiler explosion, at 55 pounds, which could not possibly be explained by shortness of water, or defective safety valve, (which was loaded to 65 pounds), or overheating, as is the case with most all explosions; neither was it an old boiler. The explosion was most violent, wrecking everything around, killing one person, seriously injuring many others, and doing a considerable amount of damage to property, while the many fragments of the boiler took a most unusual flight in altitude and distance. It is not surprising that the owners were very anxious to ascertain the cause, especially as they had other boilers in use exactly like the one that exploded. When the other boilers were examined by competent experts, they declared that the cause was in the defective design, and predicted that the other boilers could not stand double the pressure to which they were daily exposed, instead of four times the pressure, which experience has taught to be the limit of safety. They found that the top and bottom (it was a cylindrical vertical boiler) were only slightly dished, without being secured by stays of any kind whatsoever, while stays are an absolute necessity when the egg-shell form is departed from. The dishing was so slight that it was scarcely 15 per cent better than a flat bottom. In order to test this opinion, it was proposed to experiment on one of the other boilers, and burst it by hydraulic pressure. It was found that at 38 pounds the joint of the door became displaced, the ordinary mode of securing it not being sufficient. This was secured, and the experiment renewed. At 43 pounds the strain at the bottom became audible, while at 55 pounds there was a sudden sound heard and the gauges returned to zero. It was found that the shell had parted from the bottom for a length of 3 feet 4 inches through the line of rivets.

Here we have the actual bursting pressure of this boiler, which, when hot, is a little stronger, and may be set down at 60 to 70 pounds. Now, the safe working pressure should not exceed one-fourth of this, which gives only 15 to 18 pounds to the square inch for the safe working pressure.

It is not surprising, then, that this boiler, daily subjected to a strain far above this limit of safety, at last gave way. The boiler was used in a dye-house, and a copy of the inspection, with the faulty design of the boiler, has been sent to all the dyers in the district where the accident happened, for their information. A very good measure, indeed.

Humbug No. 6.—Glass Ball Insulating Casters for Beds, Pianos, Etc.

The glass ball casters at present extensively advertized by the Glass Ball Caster Co., are not a humbug in themselves, as they are as good as any other casters, and only cost a little more; but the claims made for them are preposterous.

It is claimed that by their use "bedsteads may be fully protected against danger from lightning, while, by preventing the loss of electricity or nervous fluid from the body during sleep, they will prove of great benefit to all, especially to the weak, rheumatic or nervous. Physicians have long recommended the insulation of bedsteads, which has usually been accomplished by plates of glass. The retention of electricity in the body is worth more to the patient than all the drugs that can be prescribed. Physicians may exert all their skill, and man may battle with disease, but while the life-giving and life-sustaining electric fluid escapes from the body, the efforts of both are in vain. Glass is a perfect—in fact, the only perfect non-conductor of electricity, and these casters are effective insulators."

The next claim is that they "add materially to the sweetness and volume of tone of parlor organs and pianos, by insulating the instruments. It has been the practice in Europe, and to some extent in this country, to use glass blocks for this purpose, and these casters have attracted the attention of eminent musicians who have thoroughly tested their merits, and unhesitatingly recommend them for improving the quantity and quality of tone."

Then follow testimonials from Mills, Maretzek, and others, who imagined that the tone of their pianos was increased and improved when glass casters were placed under the legs. Now, we ourselves have tried this, and with an unprejudiced mind honestly attempted to detect the difference, and must declare that it is all imagination. As it is easy to deceive listeners, by not letting them know whether the casters are placed under the legs of the piano or not, it was always found that if they believed the glass casters had been put in place, they thought the tone of the piano improved, even if nothing had been changed; and, *vice versa*, when told that the glass casters had been removed, they imagined a decrease in power and quality, while the casters were still there. *A priori*, it is absurd to expect such results, as the vibrating and sounding parts of a piano are the strings and sounding-board, while the legs have nothing to do with it, except support the case at the extremities.

In regard to the protection against lightning when placed under a bedstead, it is evident that a stroke of lightning which descends several hundred feet through the air previous to striking a house, will not be arrested by a few inches of glass ball, but will easily glide along the surfaces, or through the air under the bedstead, if there is a conducting path on or below the floor under the bedstead.

The loss of electricity during sleep is downright nonsense, and physicians who recommend such humbugs are humbugs themselves.

1,000 Per Cent vs. 13 Per Cent.

"Confession is good for the soul." So says the editor of our contemporary, the *Scientific News*, in remarking our confession of having neglected the deduction of 13 per cent in an estimate of fuel. If the "good to the soul" is in proportion to the enormity of the sin confessed, the soul of the editor of our contemporary must feel *very good*, as in the same sentence he confesses the much more serious blunder which we pointed out in his computation—namely, he finds that every building in the city will need an average evaporation of 271 cubic feet of water where he should have found 27 cubic feet. But then he adds to this the cool remark: "The main points at issue are not hereby affected." Well, let us see. It takes at least 5 pounds of coal to evaporate a cubic foot of water, so that according to that computation it would take 5×271 or 1,355 pounds of coal per day—about two-thirds of a ton to heat each of the buildings in the city with steam, instead of 135 pounds, as he should have found, had he not blundered 1,000 per cent above the correct estimate. Not to have noticed the absurdity of such a result from his calculation, or to have discovered such an enormous blunder, until we drew his attention to it, should have made him hide his diminished head, instead of crowing about our confession of the neglect to deduce 13 per cent.

It is certain that the consumption of fuel may vary this much on different days, from varying circumstances, such as different qualities of coal, new hands attending the fires, change of weather, etc., but he cannot claim that it will ever vary 1,000 per cent.

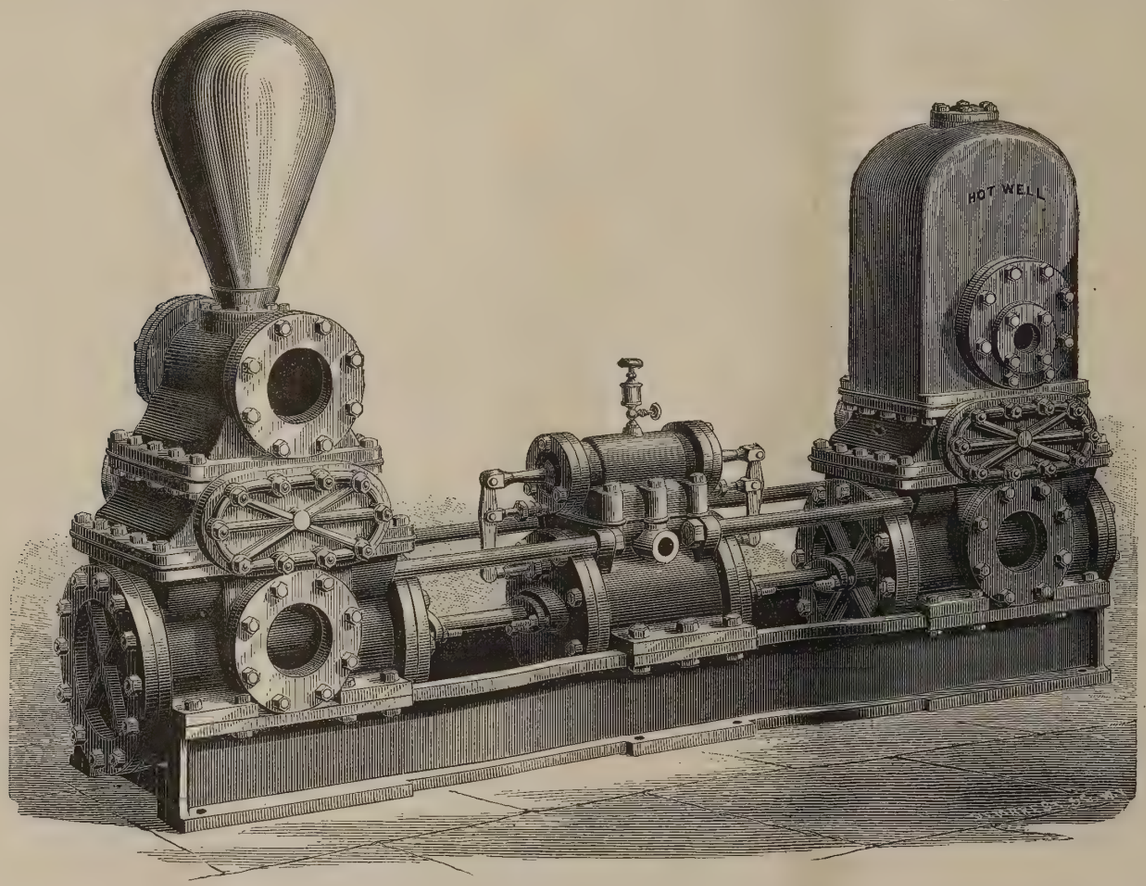
Combined Air and Circulating Pumps.

We represent in the accompanying engraving a combined air and circulating pump, especially adapted for steamships, river boats, steam tugs, etc., and which is one of the latest products of the prolific pump works of the George F. Blake Manufacturing Co. Recent as is its manufacture, it has already been successfully introduced, and has been adopted by the leading marine engine builders, such as John Roach & Son; Pusey, Jones & Co.; Babcock & Wilcox; Ward & Stanton; the Delamater Iron Works; the Harlan & Hollingsworth Manufacturing Co.; the Atlantic Steam Engine Works, etc.

The steam cylinder, with its piston, is arranged in the middle, while two piston rods project out of both cylinder heads, one connecting with the piston in the air cylinder, and the other with the piston in the water cylinder. The three pistons move simultaneously on the admission of steam to the steam cylinder. It is evident that this happy combination of three cylinders possesses the advantages of a compactness, simplicity and economy never before introduced for any marine or other condensing engine. The design is evidently new and original, as well as the whole idea upon which it is based, and it is certain that thus far there has been nothing produced like it in regard to novelty and usefulness as well as other meritorious peculiarities.

It is claimed as the most important features of this combined air and circulating pump: 1st. That the cost is much less than the usual arrangement of connected pumps. 2d. That it does away with the complication of eccentrics, keys, rocker arms, journals, etc. 3d. That it is very compact, and therefore occupies little space, which is a very important feature on shipboard. 4th. That it is placed upon a very solid bed plate, and therefore requires no expensive foundation. 5th. That it relieves the main engine of "drag," and cannot be affected when the main engine "races." 6th. That it can start a vacuum before the main engine is moved. 7th. That by its use the vacuum and the temperature of the feed-water can be easily regulated by the speed being varied when necessary.

We may add to all this another advantage. It becomes a considerable item of expense, when, at foreign ports, where fresh water has to be purchased (in many cases amounting to several hundred dollars for a single steamer) for the use of the donkey boiler; but with the use of a small independent surface condenser and one of the Blake combined air and circulating pumps, no fresh water is required; thus a great saving to the owners of the steamers every time the steamer is in port, for all the hoisting engines and steam pump's exhaust into the condenser. Besides saving the expense of buying fresh water, it saves coal, as the donkey engines exhaust into vacuum instead of against the atmospheric pressure, as is the usual custom. There are several steamers sailing from this port that have this improved apparatus, among them the steamers Niagara, Saratoga, City of Alexandria, Louisiana, and Santiago.



COMBINED AIR AND CIRCULATING PUMP.

We will only add that the machine here represented has a 12-inch steam cylinder, 14-inch air cylinder, 12-inch water cylinder, and 12-inch stroke. The valve plates, valve bolts, stuffing boxes, linings, pistons, and piston rods of the air and water cylinders are substantially made of composition metal.

For further details we refer those interested to the office of the George F. Blake Manufacturing Company, 86 and 88 Liberty street, New York.

An Electric Sentinel.

Persons who have occasion to cross the Providence railroad on Washington street, at Forest Hill, Boston, are frequently surprised to hear a heavy gong continually ringing on a danger-signal post close by, while no approaching train is seen or heard; but from three to five minutes after the alarm first sounds a train dashes around the curve and speeds along, while, as it leaves the crossing, the gong ceases to ring. This crossing signal is part of the system of the Union Electric Signal Company. It is known as the Union Electric Signal, and is exceedingly simple. By this system electricity is carried in the rails, holes being drilled in the flanges, into which wire is inserted uniting the points. A one-gravity cell battery is connected by wires to the rails, at the end of a section of one mile, and a signal level upon a post at the other end of the section. Thus the current of electricity is continuous from the battery to the signal. When the train enters upon the section the current is taken upon the wheels and axles, and so, being withdrawn from the lever, it flies up, and a danger signal is set. So long as the train is on the section, the signal remains set and ringing at "danger" until the gate is dropped. One of the great advantages of the Union system is the fact that a broken rail would break the circuit and at once show the danger. A piece of iron wire laid across the rails breaks the circuit, and the warning is given at the signal. Some time since a stray goat dragged a small iron chain across the Providence road nearly half a mile above the Forest Hill crossing, and while the chain was passing over the rails the circuit was cut, the danger bell rung, and the danger signal was set at the station.

Cutting Glass with Scissors.

Very few persons are aware that glass can be cut with scissors or shears, if it is only kept under water, the pressure of which prevents the small pieces cut off from flying away and the cracking of the large piece. The glass must be kept as deeply under the water as the bowl or pail will permit; but the cutting cannot be done like cutting cardboard, for instance: a piece of glass cannot be cut in two; in attempting this it may break in the wrong place and produce more than two pieces—it is only possible to trim edges and corners in this way, so as to reduce the shape gradually to that required. Soft glass is the best for the operation. It is not necessary that the scissors should be sharp, their action not appearing to depend on the state of their edge. Ovals and segments can be easily cut in this manner when a diamond is not at hand; and although such cutting may leave the edges of the glass not quite so smooth, yet the process is often perfectly satisfactory.

Rules for the Management of Steam Boilers.

We referred recently to the rules for the conduct of engineers in regard to the management of their boilers, which are prescribed in England, and exhibited in some engine and boiler rooms, for the guidance of those who have charge of the boilers. We are indebted to the Hartford Steam Boiler Inspection and Insurance Co., for the following rules, which they expose near the boiler of which they have charge:

1. *Condition of the Water.*—The first duty of an engineer, when he enters his boiler room in the morning, is to ascertain how many gauges of water there are in his boilers. Never unbank nor replenish the fires until this is done. Accidents have occurred, and many boilers have been entirely ruined from neglect of this precaution.

2. *Low Water.*—In case of low water, immediately cover the fires with ashes, or, if no ashes are at hand, use fresh coal. Do not turn on the feed under any circumstances, nor tamper with or open the safety valve. Let the steam outlets remain as they are.

3. *In case of Foaming.*—Close the throttle, and keep closed long enough to show true level of water. If that level is sufficiently high, feeding and blowing will usually suffice to correct the evil. In cases of violent foaming, caused by dirty water, or change from salt to fresh, or *vice versa*, in addition to the action above stated, check draft and cover fires with fresh coal.

4. *Leaks.*—When leaks are discovered, they should be repaired as soon as possible.

5. *Blowing Off.*—Blow down, under a pressure not exceeding 20 pounds, at least once in two weeks—every Saturday night would be better. In case the feed becomes muddy, blow out 6 or 8 inches every day. Where surface blow cocks are used, they should be often opened for a few moments at a time.

6. *Filling up the Boiler.*—After blowing down, allow the boiler to become cool before filling again. Cold water, pumped into hot boilers, is very injurious from sudden contraction.

7. *Exterior of Boiler.*—Care should be taken that no water comes in contact with the exterior of the boiler, either from leaky joints or other causes.

8. *Removing Deposit and Sediment.*—In tubular boilers the hand-holes should be often opened, and all collections removed from over the fire. Also, when boilers are fed in front and blown off through the same pipe, the collection of mud or sediment in the rear end should be often removed.

9. *Safety Valves.*—Raise the safety valves cautiously and frequently, as they are liable to become fast in their seats, and useless for the purpose intended.

10. *Safety Valve and Pressure Gauge.*—Should the gauge at any time indicate the limit of pressure allowed by this company, see that the safety valves are blowing off. In case of difference, notify the company's inspector.

11. *Gauge Cocks—Glass Gauges.*—Keep gauge cocks clear, and in constant use. Glass gauges should not be relied on altogether.

12. *Blisters.*—When a blister appears there must be no delay in having it carefully examined and trimmed, or patched, as the case may require.

13. *Clean Sheets.*—Particular care should be taken to keep sheets and parts of boilers exposed to the fire perfectly clean, also all tubes, flues, and connections well swept. This is particularly necessary where wood or soft coal is used as fuel.

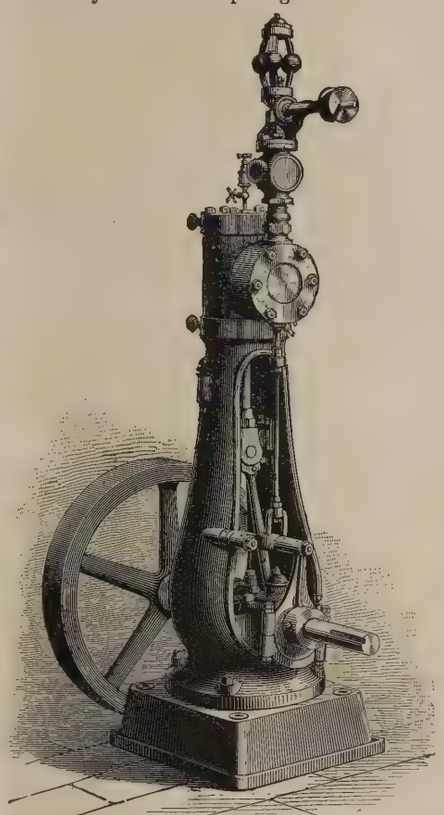
14. *General Care of Boilers and Connections.*—Under all circumstances keep the gauges, cocks, etc., clean and in good order, and things generally in and about the engine and boiler room in a neat condition.

Tramps.—Fifty years ago there were no tramps, but there were plenty of apprentices. Then everybody could learn a trade; now boys are shut out by the arbitrary laws of trades' unions; manufacturers dare not employ any boys, and the beneficent, time-honored apprenticeship is entirely abolished. Boys without trades grow up without education, and become idle members of society, living upon their relatives when times are good, and when they cannot keep them longer, the youngsters are turned loose upon society perfect outlaws. If the apprentice system can be again introduced, which means the destruction or modification of trades' unions, we shall see a wholesome change. Tramps are the result of the abolishment of the apprentice system; let us encourage home manufactures and home manufacturers by teaching trades to the young.

The Advantages of Vertical Steam Engines.

We have always advocated the use of vertical steam engines in any case where it is possible to apply them, and we see with satisfaction that we were right, that their use is spreading more and more, and that hundreds of horizontal engines are being displaced by vertical ones.

This is by no means surprising when we consider



Independent, or Double Crank Steam Engine.

that: 1st. They take up much less room than a horizontal engine. 2d. Cylinder, piston, and piston rod being vertical, there is no unequal bearing on one side, as is the case with a horizontal engine, in which the cylinder always carries on one side the weight of the piston and piston rod, resulting, especially in large, heavy engines, in an unequal wear, and finally a necessity of turning out the cylinder and adjusting the piston, as they lose their forms; while in a vertical engine there is no possible danger of unequal wear. 3d. The simplicity in design and construction is altogether in favor of the vertical engine. 4th. Accessability of parts, which is of great importance in a steam engine, as every engineer knows, and is always much easier in the vertical engine. 5th. Convenience in setting them up, running them, and keeping them well lubricated, all of which is easier in a vertical engine. 6th. Less liability of causing accidents to people, as the principal moving parts are more out of the way. 7th and lastly, but for many purchasers not the least important, lower price, as an upright steam engine costs less than a horizontal one of the same actual power.

We call attention to the vertical engine represented on this page. It is the product of the well known New York Safety Steam Power Co., who began the manufacture of these engines about ten years ago, and have in the meantime sold upwards of one thousand of them. Probably no other engine in the market is equally popular, and certainly no other is more deserving.

These engines, which the adjoined engraving represents, have always been constructed at the works of Nichols & Longworthy, Hope Valley, R. I. They are built with the utmost nicety and care on the interchangeable plan, and by the wholesale, as it were, a large number of engines of a size being built at once. Accurate workmanship and fine finish of working parts of an engine are sometimes regarded as needless, and some think it economy to buy engines lacking in these respects, but stated to be "just as good." Experience teaches, however, that it is with a steam engine as with a human being—a careless exterior is an indication of a careless and rough interior. Experience also shows that the nice and proper fit of all parts has an important influence on the daily performance and the term of usefulness of an engine to a much greater degree perhaps than in any other of the supplementary machines in a factory.

The engines of the New York Safety Steam Power Co. are preëminently and notedly of very fine finish throughout. No detail is carelessly treated, or half done. A critical steam test of every engine is made before it leaves the shop, and the adjustments are carefully made, so that the machine is all ready to start up the moment it is placed in position, connected, and the steam turned on.

The style of the engine is seen from the adjoined engraving. It will be understood that there are two bearings for the crank shaft, both being cast solid with the column, as are also the cross-head slides. There can be, in consequence, no derangement of lines and no unequal pressure of parts; the bearings are long and the shafts of large diameter, giving both large area of bearings and strength in excess of any reasonable duty. This style of engine is known as "Independent," or double crank engine, and is made in eight sizes—2, 3, 4, 5, 6, 8, 10 and 12 horse-power. The prices are low.

The headquarters of the New York Safety Steam Power Co. are at 30 Cortlandt street, New York; in Philadelphia, Kelly & Ludwig, 720 Filbert street, are agents; in Boston, the Boston Blower Co., are agents. Both agencies carry a line of goods on exhibition.

Incombustible Lamp Wicks.

Lamp wicks of asbestos are quite old; they possess several advantages, also shared by the newer kind of wick made of spun glass thread. The advantages are, as is claimed, that the flame clings closely to the wick, so that lighted lamps may be carried about without fear of their being extinguished by sudden draughts; moreover, no sparks are liberated from it. With an equal amount of this wick turned up, a much brighter and clearer light is obtained than where cotton ones are used. The smoking is greatly reduced, and at least 10 per cent of oil is saved. There is scarcely any waste of the wick itself, and the troublesome trimming and cutting to which lamp-burners are accustomed are altogether needless, for no portion of it is carbonized. Used in spirit lamps, it greatly increases the heat of the flame; and, finally, it can be produced and sold at a cheap rate.

In regard to the carbonizing of the wick, it should be understood that good kerosene must be used, otherwise impurities in the oil will settle on the wick and make it as dirty as a cotton wick.

Peculiarities of Rapid Motion.—If a musket ball be fired into the water it will not only rebound, but be flattened; if fired through a pane of glass, it will make a hole the size of the ball without cracking the glass; if the glass be suspended by a thread it will make no difference, and the thread will not even vibrate. When a tallow candle is loaded in a musket and fired at a board of not too hard a wood, it will make a hole in the board. If a round disk of paper is turned very rapidly on a lathe, its edge will cut the fingers like a knife; and if such a disk of sheet-iron is turned with sufficient velocity, it will even cut steel.

Subterraneous Currents of Electricity.

We have received a letter from the Prescott brothers, in which they complain that scientific journals and men are prejudiced against them, and do them injustice without a candid and impartial previous investigation.

That we are not prejudiced, and willing to do them justice, so far as they deserve it, we have shown in acknowledging that their lightning rods may be very good. The only thing we object to is their use of the divining rod. Now, in order to show that we intend fair treatment in this matter, we will here publish the principal portions of their letter, containing an account of how they came to what they appear honestly to believe—the discovery of subterranean electric currents, which we do not deny, but only the way they put it; we do deny in toto and emphatically, however, their claim that electric currents can be detected by diving rods. The letter referred to says:

"Three years ago last July, after careful and very extended tests and investigations, we made and introduced what we term the "Prescott Protection" from lightning. The said protection consists in connecting the ground terminus of a lightning rod with what we call ground electrical currents, or lines of attraction, which traverse the earth's surface in every conceivable direction. These currents are often found running parallel with each other, then again others cross at right angles, or diagonally, and so form a complete network, so to speak, of attractive lines in all directions. These lines at certain places are more numerous than at others; then again several square rods exist without any.

"These lines or currents almost invariably assume a straight course, or very nearly so; sometimes a gradual curve exists, and again one intersects with another and stops, or T's on. These currents are manifestly perpendicular over and in connection with subterranean streams of living water, such as supply springs of flowing water.

"Now comes the value of being able to trace and locate these sources. We have found that, after making more than 7,000 actual tests, where lightning has struck—no matter what the object, whether tree, house, telegraph pole, lightning rod, or creature in the field, carriage on the road, or person on foot—each and every one was connected with these currents at the surface of the earth, and with no variation whatever. We have also proved that no object was ever struck off from these currents, and therefore if a building happens to be located off from them there is no need of protection, as the location itself is protection. We have also found that the long-claimed moist earth connection is not essential in placing a lightning rod, as the surface is the point of attraction, and the water or moist earth has no attraction, but is merely a conductor. In regard to 'water finding its own level through the different strata of the earth, the friction of which produces electricity, which manifests itself at the surface directly over such strata,' we admit is theorizing. But this much we do know, that such manifestations do exist; and whether or not it is the friction of the flowing subterraneous stream below against the earth substances in which it is confined, making electricity manifest at the surface of the earth nearest this continual disturbance, which would be directly over it, it is impossible for us to positively state. But there is a relationship between the two like this, namely, when we cut off the stream below by digging from the surface down to it, as in digging a well, all manifestations of electricity cease between the point of digging or well and the outlet or spring where the subterraneous stream comes to the surface. At the same time the electrical manifestations remain the same between the well and the source of the stream. The question is often asked how we know these manifestations we speak of to be electricity. We answer, there are numerous reasons that space will not admit of here; but the best of all is insulation—that is, if we insulate ourselves perfectly from the earth, no indication of electricity is visible, but remove the insulation and its presence is complete. But whether electricity, magnetism, or not, it does not matter, so long as we know that to such currents as we have here described lightning always strikes.

"One word about our manner of work: First, we make an examination of the ground connection of the building, or whatever object the person asks us to protect. If the result of that examination is that there is no electrical current under it, we pronounce the building free from all possibility of ever being struck by lightning, and therefore needs no rod protection. On the other hand, if, in making this test or examination, we find one or more currents, we properly protect the highest and most prominent parts by using a good lightning rod and leading in the most direct practical route to the current where it passes under the building, and another leader or ground connection where it comes out, and nowhere else, as these two points are the only places where a rod can connect with this current of attraction, and it is the only thing that makes the building liable to lightning strokes; and the principle of rodding is to give the lightning a better road or conductor than the object we are protecting. After doing this by first finding out the attractive point, and making a proper connection with the same, there never can be a failure of a lightning rod put up in this manner, as there never has been. If there is more than one current we surely connect one rod with each current, as the attraction is independent of each individual current, and of course all should be protected.

"Now, for the past failures of the lightning rod. In the first place, there is a current under the building, or it would not have been struck; second, the rod does not connect at the ground with this current, and therefore the rod is not a connecting link between the cloud and the point of attraction, hence is not a conductor in the true sense of the word, as the proper connection is not made with the rod, but the building makes it, hence what is termed 'leaving the rod' takes place. Actual tests and facts prove these assertions.

"On the other hand, once in awhile a rod happens by chance to make a proper connection, and if struck, protects the building. These cases, however, are quite rare, as actual testing has proven to us and newspaper reports verify. . . .

"We agree with Prof. Anderson that science has been very slow in protecting life and property from lightning, but beg to differ very essentially from the MANUFACTURER AND BUILDER in regard to Mr. Spang's manner of protection. . . .

"There is much more we could say perhaps to advantage, but felt called upon to say this much for ourselves after so much ridicule has been heaped upon us by parties and papers that have no conceivable idea of our work and discovery, but seem to take it for granted that we are another lightning rod swindle. Before closing we wish to make this earnest appeal to all scientific men, editors and professors, that we stand ready and anxious to meet them anywhere this side of New York to prove our discovery. No man can point his finger to a party that we have worked for who is not more than satisfied, and feels a relief from lightning he never knew before.

"Our manner of procedure is to enter a town or city, make known our discovery and manner of protection, and solicit any test that the citizens may subject us to pertaining to our work, to prove to all that we can and are willing to practice what we preach. We readjust a great many old rods already on, and also find many buildings rodded that need none.

"As to the divining rod, we can show what can be done with it better than we can write."

PROGRESS OF THE TELEPHONE IN FRANCE.—Three telephone companies have been formed in Paris; they have now been consolidated, and a capital of 10,000,000 francs paid in, half of which is devoted to buying the patents and the interests of the three old companies, and the other half for expenses of offices, wires, apparatus, etc. Six hundred lines are already in operation, and others are in course of construction.

Knowledge that Costs Dear.

The work on the Brooklyn approach to the East River Bridge has been finished up to Prospect st., with the exception of dressing off the surface for the roadways and promenades. In the spring the old St Ann's Church will be torn down, and the approach will be carried up to Washington and Sands streets, where it will meet the level of the street. The parapet stones and the granite balustrades are in position, and the imposing appearance of this part of the work shows to advantage, but its full effort is destroyed by the number of buildings that cut off a view from a distance. The working force is at present concentrated upon the approach on this side of the river, to push that ahead with all possible speed while working weather lasts. An unusually large force of men is at work for this time of the year.

The first of the iron work for the superstructure will be delivered this month. The contractors have delayed to get the proper machinery for rolling the steel, and the engineers have been willing to tolerate the delay to have the material of the best possible manufacture. The towers have been cleared of all rubbish, and are ready to receive the steel for the roadway. The work upon the roadway will be begun at the towers and carried toward the center of the river and toward the anchorages. The suspenders that are now in position are for the first part of the superstructure. The suspenders for the entire length of the bridge are made and are ready to be put up, but the force of the wind, which is greater, it is said, upon the East River than at almost any other point about New York, would tangle the wire rope up if too many of the suspenders were put in place at once. The "members" of the superstructure are to be severely tested. It is hoped by testing a number of the sections of the superstructure in the great testing machine built by the Government in the Springfield arsenal, that the margin of safety may be reduced. This experimenting is so expensive that railroad and other corporations having bridges to build would not consent to enlighten the profession of civil engineering by such elaborate tests as are necessary to give the engineers a more intimate acquaintance with the strength of steel and iron. This is the most favorable opportunity for obtaining the information desired and, although it will add to the cost of the bridge, the engineers look upon it as for the public good.

A Royal Car.

The Jackson & Sharp Company have just finished a narrow-gauge railroad car for King Oscar of Norway and Sweden, which, for beauty and convenience, is unequalled even by the one recently built by the same firm for Dom Pedro, which was exhibited at the Centennial Exhibition. The car is built low, to suit the numerous tunnels which occur among the mountain cliffs for which Norway and Sweden are noted, and is divided into three compartments. The smaller compartment is used for a toilet room, and also contains the heating apparatus. It is elaborately finished, and furnished with every convenience which would contribute to the hygienic requirements and comfort of the occupants.

At the opposite end of the car is a large compartment for the king and his suite. It is finished in princely style with chairs upholstered with plush. The middle and large compartment is the parlor and royal rooms, furnished with sofas, chairs, lounges and very finely finished tables. The upholstery is of sage green silk tapestry, and is undoubtedly among the finest specimens of workmanship. The woods of which the interior is finished are maple, walnut and satinwood veneering, to which a very brilliant polish is imparted by the most skillful artisans. Violet predominates in the various shades in which the ceiling is finished, and is in perfect harmony with the velvety Brussels which covers the floor.

Many railroads now have in use a valuable lamp, called the "quick signal railroad lamp"—a red and white light combined in the same lantern.

Celluloid—What it is, and How it is Made.

Dr. Wm. H. Wahl, contributes the following interesting facts regarding the manufacture and uses of celluloid to the *Journal of the Franklin Institute.* The article is one of the most comprehensive and concise that has been written upon the subject:

"The multifarious uses which this remarkable substance is made to serve, and which appear to be constantly increasing, as well as the fact that but little is generally known concerning its composition or the methods of producing it, render it probable that a few words concerning it may prove of interest.

"Celluloid, briefly defined, is a species of solidified collodion, produced by dissolving gun-cotton (pyroxylin) in camphor with the aid of heat and pressure.

"The nature of this product and the methods of procedure employed in its manufacture will be found described in what follows. First, let us devote a few lines to an account of the materials employed; and here, as of prime importance, we must begin with gun-cotton.

"When cellulose, or wood fiber (under which terms are included common cotton, paper or paper-pulp, the refuse of cotton mills and vegetable fiber of every description), is immersed for a few minutes in a bath composed of a mixture of strong nitric and sulphuric acids, then removed and washed and dried, it will be found to have acquired new and remarkable qualities. In external appearance there is nothing to indicate that any change has taken place, but when the test is made it will be found to have become highly inflammable, and (if the action of the bath has been sufficiently prolonged and intense) even highly explosive. Wood fiber, or, to give it its proper chemical name, cellulose, thus treated, is said to have been nitrated, and the resultant product is termed nitro-cellulose, pyroxylin, or, popularly, gun-cotton. The latter term is given to it because, when properly prepared, it can be used as a substitute for gunpowder, having explosive qualities considerably greater than the latter. A number of substances beside cellulose, when treated in the manner above described, acquire similar inflammable or explosive properties, among which may be named sugar, starch and glycerin; the nitro-compound of the last-named substance being nothing else than that most terrible and energetic of known explosive agents—nitroglycerin.

"Besides acquiring inflammable and explosive properties, the cotton (supposing, for sake of illustration, that we have used this common form of cellulose), after treatment as above described, has taken on another quality, namely, that of ready solubility in certain menstrua which are utterly without action on common cotton. For example, it will be found to gelatinize and quickly disappear in a mixture of alcohol and ether, forming a thick, transparent liquid. This is the same material used by photographers, who, in taking a picture, first spread a thin film of this solution, called collodion, upon a glass plate. The ether and alcohol being volatile quickly evaporate, leaving behind a thin, smooth and tenacious membrane or film of gun-cotton, which serves as the medium of holding the sensitive silver compound used in taking the photographic image. It is upon this property of ready solubility of gun-cotton that the manufacture of 'celluloid' depends, as we shall presently see; and the secret of its production depends upon the fact that camphor, like ether and alcohol, will readily dissolve gun-cotton. Prof. Seely, so far as the writer is informed, was the first to observe that gun-cotton would dissolve in an alcoholic solution of camphor, and the brothers Hyatt after many experimental trials, succeeded in perfecting and patenting a procedure, whereby camphor mingled with finely pulped gun-cotton, is made to exert its solvent effect upon this substance, with the aid of heat (fusion) and pressure in a closed chamber (to prevent the volatilization of the camphor). The following is an abstract of their method:

"Gun-cotton is ground in water to a fine pulp in a machine similar to that used in grinding paper pulp; the pulp is then subjected to powerful pressure in a perforated vessel, to extract the bulk of the moisture, but still leaving it slightly moist for the next operation. This consists in thoroughly incorporating finely comminuted gum-camphor with the moist gun-cotton pulp in the condition last named. The proportions employed are said to be one part by weight of camphor to two parts by weight of the pulp.

"With the camphor and pulp, the patentees further state that they also incorporate any pigments, coloring matter, or other materials that may be adapted to the requirements of the articles into which the product is to be manufactured.

"The mixture of pulp, camphor and pigments having been made, the next step is to subject the mass to powerful pressure, in order to expel from it the remaining traces of moisture, and incidentally to effect also the more intimate contact of the camphor with the pulp. The dried and compressed mass is next placed in a mold open at the top, into which fits a solid plunger. The vessel is next placed in a hydraulic (or other) press, and heavy pressure, applied to the plunger is brought to bear upon the mixture. While thus under pressure the mixture is heated by means of a steam jacket surrounding the chamber, or by other means, to about 300° Fah.; at this temperature the camphor fuses and, its volatilization being impossible, the melted gum dissolves the gun-cotton pulp, or, to use the words of the patentees, 'converts' it. The patentees further state that the process of transformation is rapidly effected when the right temperature is reached, and the product which results is the homogeneous solidified collodion, known as celluloid. After the mass is taken from the press, it hardens and acquires the extraordinary toughness and elasticity which are the distinguishing characteristics of the product; and one of the most noteworthy circumstances connected with it is the fact that a large portion of the camphor which it contains appears to be permanently held or combined with it, if we may use this convenient (though not strictly correct) term, so that its property of volatilization when exposed to the air is practically arrested.

"There are several varieties or modifications of the above-named procedure which would require too much of our space to detail. The process commonly employed in the production of celluloid is substantially that which we have given; and the endless variety of colors that the products of celluloid possess are obtained simply by proper admixtures of pigments in the operation of its manufacture; mottled and other peculiar effects require special manipulation, which our technical readers will not find it difficult to understand. It should be remarked, also, that the celluloid made as above detailed can be rendered plastic again, and remolded into any desired shape without further additions.

"As to the applications of celluloid, they are legion, and we can only name the more prominent of them.

"As a substitute for ivory it is perhaps best known, and has been so successfully substituted for it for many uses to which ivory was formerly put, as to have made serious inroads upon the business of the ivory importers and workers. So perfect is the resemblance of celluloid to ivory that a close inspection is required to distinguish the counterfeit from the genuine. The absence of 'grain' is perhaps the readiest peculiarity by which goods of celluloid may be detected, but, for all practical purposes, it is not only as good, but also in some respects better than ivory for all the uses of that substance. It (celluloid) possesses not only all the strength and elasticity of ivory, but it does not warp nor discolor with age.

"On these accounts it is now largely used in place of ivory in making piano and organ keys, billiard balls (said to be equal in elasticity to those of ivory), combs, backs of brushes and hand mirrors, plates for ivorytypes, for looking glasses, and portraits, handles for knives and forks, whips, canes and umbrellas, and other objects too numerous to name for which ivory is used; and not the least of its advantages as a substitute for this substance is the fact that it can be molded, a property which renders it possible to reproduce the most delicate and elaborate decoration on articles fashioned out of it at a fraction of the cost of similarly ornamented goods of ivory, and some of the other materials imitated.

"Hard-rubber, it is said, is able, on account of its cheapness to hold its own against celluloid very well; but tortoise shell, malachite, amber, pink-coral, and other costly and elegant materials are so successfully imitated that an expert must look sharply to detect the original from the copy. In imitation of tortoise shell, it is made in such articles as combs, card-cases, cigar-cases, match-boxes, napkin-rings, etc. The pink-coral, so popular for jewelry, is admirably imitated, and the imitation sold at prices considerably below those of the genuine article; and the same may be said of articles imitating malachite and amber. Mouth-pieces for pipes, cigar-holders and musical instruments, cleverly substituting the last named are quite common.

"Celluloid is used also as a substitute for porcelain in making dolls' heads that will stand any amount of hard usage. It is used in place of tortoise shell and hard-rubber for the frames of eye-glasses, spectacles and opera-glasses, for shoe-tips in place of metal, for martingale-rings, emery-wheels and knife-sharpeners. The latest thing in celluloid, and certainly the most novel, is its use, in combination with linen, cotton or paper, for shirt bosoms, cuffs and collars. These goods are possessed of a luster which very cleverly imitates that of freshly laundried linen; they are remarkably strong, elastic and durable, and are completely impervious to moisture, and of course to perspiration. When soiled they require only to be wiped off with a moistened sponge, or cloth, to have their freshness restored, and can be made to do service for a long time.

"What new uses for this extraordinary product the future may develop no one knows, but it is safe to say from what has already been achieved with it, that its production is deserving of a rank beside that of vulcanized rubber, as one of the most remarkable inventions of the age."

The Audiphone.

Several exhibitions have been given of late showing how much deaf and dumb persons may be assisted in hearing by the use of an instrument called the Audiphone, by which sound is conveyed through the medium of the teeth and auditory nerve. The inventor of the audiphone is Mr. Richard S. Rhodes, of Chicago, who is very deaf. The instrument was suggested to him about two years ago, by the discovery that on placing his watch against his teeth he could distinctly hear its ticking, though unable to do so upon the usual application to the ear. After a year's work he perfected the instrument. It closely resembles a black fan; it consists essentially of a diaphragm of hard rubber, very thin and elastic, about a foot square, with rounding corners and a neat hard-rubber handle. When in use a silken cord draws down on the inside the top of the diaphragm, presenting a convex surface to the speaker. In this position the upper edge is pressed firmly against the interior edge of the upper teeth, and the sound falling upon this surface is conveyed to the auditory nerve.

At a recent exhibition in Philadelphia, a young man seventeen years old, who has been deaf since he was nine years old, but who could answer vocally questions asked by the sign language, was brought forward. When the audiphone was adjusted to his teeth, Mr. Rhodes asked his name in a loud voice. The boy evidently reaped a new experience, for his face lighted up with a smile. "I heard it, but I don't know what it was," he said.

At Hartford, Conn., two ladies sang a duet, with piano accompaniment, before the children in the Deaf and Dumb Asylum, and the children, on being asked how many heard it, three-fourths of them raised their hands; but upon being questioned, they generally asserted that they heard the piano, but could not hear the voices. The "laughing song" manifestly pleased some of the children.

Building Intelligence.

NEW YORK CITY BUILDING ITEMS.

The site for a new building, to be occupied by the Mercantile Library, has just been bought by the Clinton Hall Association, for $180,000. The plot is on the southeast corner of Broadway and Thirty-seventh street, measuring 106 feet on Broadway by 136 feet on the street adjoining. It is intended to begin the erection of the building next spring. The structure is to cover the entire plot, and will cost, with the fixtures, from $180,000 to $200,000. The lower part is to be rented for stores, and the whole upper part will be occupied for the library, reading room and gymnasium. No plans for this building have been made, and it has not even been decided whether it will be constructed of iron, stone or brick.

The residences to be built by the Vanderbilts—Wm. H., Cornelius and William K.—on Fifth avenue and which have already been referred to in this department will be among the most conspicuous architectural ornaments in the city. The cost of these dwellings will be $1,650,000, and the plans have already been filed in the Department of Buildings. The house which Cornelius will build is the most luxurious and will cost three quarters of a million. William K. Vanderbilt's residence will cost $200,000, and that of Wm. H. will be valued at $700,000. The lots which the latter has chosen are situated on Fifth avenue, between Fifty-first and Fifty-second streets. Two buildings are projected —single and double flat roofed dwellings, the former being intended for one family and the latter for two. A frontage of 103 5-12 feet and a depth of 150 feet form the proportions of the lots on which both are to be built. The material chosen for the outer walls is Connecticut brown stone, and the style of architecture, though modern, will, in some respects, resemble the Doric and Corinthian. The two buildings will practically be one, having, as they will, a common entrance from Fifth avenue to a grand vestibule and corridor uniting them. The arrangement is exceedingly unique. The house of Cornelius will be on the northwest corner of Fifth avenue and Fifty-seventh street. From the drawings filed it appears that the massive stone front will be on the Elizabethan style, richly ornamented with carvings, and with the upper portion of its first and second story windows composed of richly stained glass. The dining room, which is to be a great double-story extension 24x74 feet in extent, will be almost entirely of glass, stained and ground. The roof will be a combination of flat, peak, and Mansard; the covering of the dining room a dome of stained glass. William K. Vanderbilt's house will stand on the northwest corner of Fifth avenue and Fifty-second street. In the basement will be ten rooms and on the first floor seven. The latter is to include a parlor 34x 60 feet, with handsome bay windows, a library 18x24 feet, a dining room 32x44 feet, and a sitting room 18x 24 feet. The second, third and fourth floors are to be divided into chambers, dressing rooms, baths, etc. A combination peak roof is to be added.

MISCELLANEOUS.

Geo. O. Gamsey, architect, is preparing plans and receiving bids for a large reaper factory at Chicago. The main building will be 200x360 feet, three stories high, of brick, with stone and iron finish; the foundry, 60x200, one and a half stories high; blacksmith shop, 40x200 feet, one story high; office, 30x50 feet, one story high, and store-house 80x100 feet, two stories high, together with stacks, boiler-house and engine rooms, etc.; cost, about $50,000. Mr. Strippleman is the architect of two furniture warehouses and factories now building in that city, one for C. Seipp, Esq., corner Van Buren and Franklin streets, 100x153, of Racine pressed brick and Lemont limestone finish, four stories and basement in hight; cost, $50,000; Eastlake style; and the other for C. Kobb, Esq., on Canal and Mather streets, 40x86 feet, of pressed brick and stone finish; cost, $12,000.

The clock factory just erected on Seventh avenue, between 12th and 13th streets, Brooklyn, N. Y., by the Ansonia Clock Company, is one of the most complete establishments in the country. Erected on high ground, near what is generally known as Prospect Hill, it fills, to the extent of 250 feet square, a vacant lot that could not have been appropriated to a better purpose. The building is five stories high, the front brick, being laid in red mortar and decorated with white brick. In the center of the building is a court-yard 120 feet square, where four iron stairs lead to the various departments, to act as fire-escapes in case of danger, and all the various floors are constructed in a manner to suit the numerous minutiæ belonging to the manufacture of clocks. No less than 1,500 hands are employed in this factory. Messrs. William Field & Son were the architects.

Mr. D. K. Dean, of Erie, Pa., has recently drawn plans for a new and elegant block to be erected in that city to meet the wants of the Young Men's Christian Association. They provide for a building in the modern Gothic style, 80 front by 70 feet depth, and two stories high, with a high basement. The building will be of brick, with a front of Philadelphia pressed brick, with Ohio sandstone cappings, relieved by ornamental black brick work. The basement is planned to meet the requirements of physical culture, and will contain a gymnasium 78x32 feet, a barber shop 32x26 feet, together with bath rooms, closets, etc. The upper part of the building is taken up by a large lecture room, with a seating capacity—including a wide gallery—for 1,200 persons. A capacious speaker's platform, 60x17 feet, will hold 150 persons. The probable cost of construction, according to the plans, would not be far from $20,000.

The new building of the Phœnix Fire Insurance Co., in Brooklyn, near the City Hall, on the site of the old Montague Hall has a frontage of 69 feet on Court street and fills a lot which is 125 feet deep. Being in the principal square in Brooklyn, it is one of the most imposing structures in that city. It is seven stories high, with a mansard roof. The hight from the sidewalk to the top of the central window is 116 feet. The front is constructed of brick with trimmings of Nova Scotia stone, and the style may be called Renaissance. The entire building is intended for offices, and there are over one hundred different rooms of various dimensions. A central hallway extends the whole length of the building, and grand stairways run from the basement to the roof. All the rooms, those in front as well as in the rear, are well lighted and heated. The first and basement stairs will be finished in hardwood. On the main floor are two large offices 28x90 each, and 17 feet high. One of these offices is being fitted for the especial use of the Phœnix Fire Insurance Company, with hard wood doors and ornamental fittings throughout. The building will be ready for occupancy on the first of March. The cost will be about $100,000.

The Manhattan Beach Improvement Company has just decided upon its plans for the new hotel which it will build on Manhattan Beach during the winter and spring. It is to be the largest summer hotel yet built on the coast. It will be generally oriental in design, with graceful towers, imposing abutments and spacious piazzas, tastefully decorated with scroll-work and painted in somewhat livelier colors than the company's present hotel. It will be situated on the beach one-third of a mile to the east of the present hotel and about midway between the bathing pavilion and the United States life saving station. The southern front, which will look out on the ocean, will be five hundred feet long. In the center will be the main hall, with wings running east and west, connecting with pavilions 160 feet long, running north and south. There will also be another large extension on the east side. The southern and northern fronts will be finished alike. The architects are William Field & Son of New York. The hotel will be four stories high, the fourth to be furnished with a mansard roof with pretty dormer windows. The main hall in the center and both projecting ends of the pavilions, will be carried up three stories higher, capped by sloping slate roofs, and flanked by Moorish towers which end in tapering spires. In these towers will be some of the cosiest rooms in house. Small balconies will be scattered about in front of the windows of private parlors and sleeping rooms, and a piazza varying from twenty-four to thirty-two feet wide, similar to the large piazza of the old hotel, will encircle the entire ground floor. Around the main hall tower will be a promenade twelve feet wide, from which one will be able to see Coney Island from one end to the other, the ocean, Sheepshead and Jamaica Bays, and the main land for miles around. An awning will be put over this promenade. Through the main hall, from north to south, will run an immense corridor 30 feet wide, around the sides of which will be the offices and doors leading to the reading rooms, barber's shops, elevators and halls. A parlor, 50x88, will occupy the entire first floor of the west wing, and the upper stories will be cut up into sleeping rooms. The first floor of the east wing will be occupied by private dining rooms, and a grand dining room 62x112 feet will occupy the first floor of the east pavilion. Folding doors will lead from it into an extension dining room 46x64 feet, and at the northern and southern ends of the room windows will lead to the piazzas which overlook the bay and the ocean. On the first floor in the east extension will be dining rooms for nurses and children, and up stairs will be sleeping rooms. On the second floor of the main hall will be the large ladies' reception parlor extending from the southern to the northern part of the house, and opening at each end on wide balconies. The entire west pavilion will be devoted to rooms for guests. Large mains and drain pipes will be laid along the southern shore of the bay extending nearly to the inlet, so that the sewage from the old and new hotel will be taken out beyond tide water to a point where it cannot possibly contaminate the bay water opposite the new hotel. The foundations of the hotel will soon be laid, and the building will be finished by the middle of May or the first of June, 1880.

According to the report of the Commissioner of Labor Statistics of Ohio, the following are average prices of a day's work at the present time for each of the building trades in the cities below: Cleveland—stone masons, $2.50; bricklayers, $2.25; carpenters, $1.75; plasterers, $1.75; painters, $1.75; laborers, $1.25. Toledo—stone masons, $2.00; bricklayers, $2.25; carpenters, $1.50; plasterers, 2.25; painters, $1.25; laborers, $1.25. Steubenville—stone masons, $1.75; bricklayers, $2.00; carpenters, $1.75; plasterers, $1.75; painters, $1.50; laborers, $1.10. Zanesville—stone masons, $2.25; bricklayers, $2.25; carpenters, $1.38; plasterers, $2.25, painters, $1.25; laborers, $1.13. Ravenna—stone masons, $2.50; bricklayers, $2.50; carpenters, $1.87; plasterers, $2.50; painters, $2.25; laborers, $1.25. Columbus—stone masons, $2.00; bricklayers, $2.25; carpenters, $1.75; plasterers, $1.75; painters, $1.75; laborers, $1.25. Youngstown—stone masons, $3.00; bricklayers, 2.50; carpenters, $2.00; plasterers, $2.00; painters, $1.75; laborers, $1.25. Dayton—stone masons, $2.25; bricklayers; $2.50; carpenters, $1.75; plasterers, $2.00; painters, —; laborers, $1.25. Cincinnati—stone masons, $2.00; bricklayers, $3.00; carpenters, $2.00; plasterers, $2.00; painters, $1.75; laborers, $1.15. Springfield—stone masons, $2.50; bricklayers, $2.50; carpenters, $2.00; plasterers, $2.25; painters, $2.00; laborers, $1.25. Wooster—stone masons, $2.75; bricklayers, $2.50; carpenters, $1.75; plasterers, $2.13; painters, $1.75; laborers, $1.50. Marion—stone masons, $2.50; bricklayers, $2.50; carpenters, $1.75; plasterers, $2.25; painters, $1.00; laborers, $1.25. Canton—stone masons, $1.75; bricklayers, $2.00; carpenters, $1.50; plasterers, $1.50; painters, $1.50; laborers, $1.25. Piqua—stone masons, $2.00; bricklayers, $2.00; carpenters, $1.50; plasterers, $2.00; painters, $2.00; laborers, $1.00. Norwalk—stone masons, $2.00; bricklayers, $2.00; carpenters, $1.50; plasterers, $1.50; painters, $1.00; laborers, $1.00. Portsmouth—stone masons, $2.50; bricklayers, $2.50; carpenters, $1.50; plasterers, $1.75; painters, $1.50; laborers, $1.25. Massillon—stone masons, $2.25; bricklayers, $2.50; carpenters, $2.00; plasterers, $2.50; painters, $2.00; laborers, $1.00.

Improvements in Air Compressors.

The continually extending use of compressed air as a transmitter of power has given rise to the construction of powerful steam engines, built for the sole purpose of compressing air, and also to the invention of several important improvements, some of which we will here describe.

The reason why this method of conveying power to distant points has met with such general favor, needs only to be mentioned, without argument, to carry conviction with it. It is a transmitter of power which is not obstructed by any curvature in the line of conveyance, nor by any grade of ascent or descent; nor is it influenced by temperature in its path of transit, while experience has proved that the loss of power in the transmission does not exceed 4 per cent under the most unfavorable conditions. An incidental and most important advantage connected with this system of transmitting power, is that the escape from the engine driven by the compressed air is a most excellent agent for ventilation and cooling. It is evident that this is of the utmost importance in tunnelling—so important, indeed, that without the use of this agent the most important modern engineering works, such as the driving of the Mount Cenis, Sutro and other tunnels, would simply have been impossibilities.

Among the improvements in the machines employed for compressing the air, stand foremost those introduced in the Clayton duplex compressor, which we described in our number for January, 1877. The principal distinguishing features of that machine have been so favorably received, that they have been retained; but some improvements have been added, which have chiefly to do with the air cylinder and its adjuncts. The most important problem to solve was the best method to dispose of the heat developed during compression, at the same time lubricate the piston, and reduce the volume of clearance.

One method of accomplishing this is to interpose water between the piston and the air to be compressed; this prevents leakage, lubricates the piston, and fills up waste spaces. But the area of water in contact with the air is too small to be adequate, especially when the compression is high and the piston speed as great as is required for the economical use of steam. Another method is to inject a spray of cold water into the air cylinder during the period of compression. This is better, but it requires nice adjustment for the supply of water at a pressure above that of the air, while it produces a complete saturation of the compressed air with moisture. The third and best method is that of surrounding the cylinder with a jacket and circulating cold water through it. This method has been most favorably received, and has been adopted in the duplex air compressor of which we give a perspective view in the adjoined engraving. This water jacket is so arranged that the water enters at the ends of the cylinder, traverses its circumference, and finds its exit at the middle. As the maximum pressure takes place at the cylinder ends, they are the hottest, and introducing the water there has the effect of counteracting any tendency to unequal expansion of the metal.

The lubrication and means for reducing the volume of "clearance" which is occupied by air, takes the form, in external appearance, of a taper straight-way cock, the projecting end of the valve stem being provided with a pulley and a belt connecting it with one twice its size on the main shaft, as seen at the left-hand of the engraving. The valve is hollow and of a fixed capacity, and instead of having an opening directly through it, it has but one, which both receives and discharges. At each stroke of the compressor piston the valve-opening revolves past that part of its casing to which the pipe supplying the lubricating material is connected, is filled, cuts off the further flow of the supply, and at the completion of a half revolution empties itself into pipes which convey the oil or water to the suction valves of the air cylinder. During the period of air admission this lubricating material passes into the cylinder through the in-let valves, remains quietly on the bottom of the cylinder until the return movement of the piston commences, when it slowly rises before the advancing piston, moistening both cylinder and piston surfaces, and filling all waste space between the face of the piston and the level of the outlet, or delivery valves.

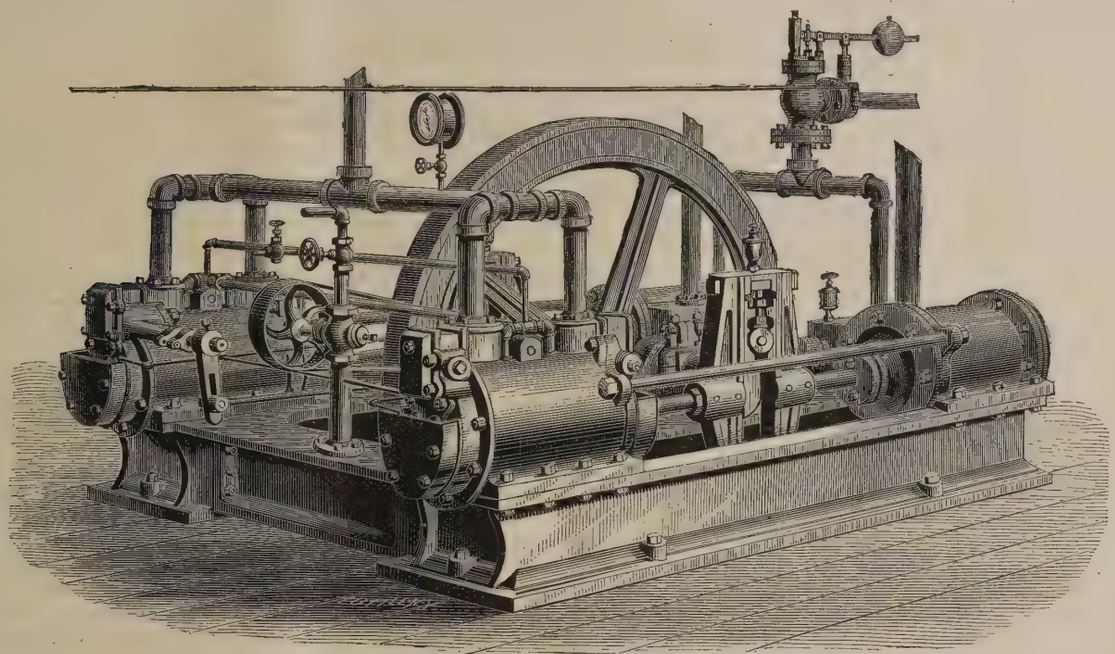
In pumping water or any non-compressible fluid, the volume of clearance in the pumping cylinder is of comparatively little importance; but in a compressor, any air remaining in the cylinder after the piston has reached its most advanced position, will re-expand to its original volume before any further supply can enter, and the capacity of any compressor is reduced by the whole of the volume of this re-expanded air at each discharge. By a system of connecting pipes between the delivery valves of the cylinder, the air receiver and the lubricator, a small quantity of oil, water, or whatever material is used first supplied to the receiver, may be used over and over indefinitely. No matter in what position the compressor may stop, there can be no flooding of the cylinder—no adjustment of supply is required, and it is unfailing in its action so long as the supply lasts.

Both the suction and discharge valves are of brass, with a disk of specially prepared material between them, which serves as a protection to the surfaces in contact, and an easily removable medium which receives the wear of valve and face.

An examination of the indicator diagrams taken from air compressors show the extra power and extra pressure required to lift the delivery valves from their seats, owing to the increased area of the valve upon which the compressed air in the delivery pipes and receiver acts to hold the valves to their seats. This excess of area is necessary to secure tight valves, and the excess of pressure required to operate them is from 30 to 50 per cent. To save this unnecessary expenditure of power and relieve the compressor from undue shock and strain, a device is employed, a part of which can be seen in the engraving; this device can be adjusted to lift the valve from its seat at the precise point of the stroke when the pressure in the cylinder becomes equal to that in the delivery pipes; its movement is positive, being connected to and operated by an eccentric on the main shaft.

In most of the operations where compressed air is required, it is essential that a uniform air pressure should be maintained in the receiver, regardless of the intermittent and irregular manner in which the air is withdrawn for use. To prevent over-pressure, or the necessity of keeping a competent man to start, stop or vary the speed, as indicated by the rising or falling pressure in the air receiver, the manufacturer has secured the exclusive use of the Steel patent air governor, which, in the case of duplex compressors, will maintain a uniform air pressure under all circumstances, so long as the demand does not exceed the maximum capacity of the compressor to supply.

An examination of these compressors shows how prominently the manufacturer has kept in view the acknowledged engineering requirements, and even in some instances has anticipated them. These compressors are built in a variety of sizes and styles, adapted for being driven by steam, water, belt, gearing, or wire rope. The manufacturer, Mr. James Clayton, of 14 and 16 Water street, Brooklyn, N. Y., will be pleased to send by mail to those interested, illustrated circulars describing his air compressors, air and vacuum pumps, steam pumps, etc.



IMPROVED AIR COMPRESSOR.

Protection of Iron Machinery.—Rub 1 part of graphite to a powder, add 4 parts of sulphate of lead, 1 part of sulphate of zinc, and 16 parts of linseed oil varnish; mix well and boil. This forms a varnish which no weather will wash off.

Sanitary Construction and Arrangements of Dwellings.

BY PROF. W. H. CORFIELD, M.A., M.D.

(*Continued from Page 274 of December Number.*)

Where French casement windows are used, as they sometimes are unadvisedly in this climate, ventilation may be provided by having a louvered opening above the casements of the window, or by making a glass pane or panes capable of being swung forward on the lower edge. Lastly, Cooper's ventilator is largely used for windows, and also in the glass panes over street doors. It consists of a circular disk of glass, with five holes in it, placed in front of a pane of glass with five similar holes, and working on an ivory pivot at its center. It can be moved so that the holes in it are opposite to those in the window pane, when air will, of course, come in; or so that they are opposite to the places between the holes in the panes, when the air will be prevented from entering. It is obvious that the air is not admitted in an upward direction, but the disadvantage of this is partly counterbalanced by the fact that it is admitted in five small streams, and not in one large one, so that there is less probability of a draught. The air may also be admitted through apertures made in the walls or doors. The simplest way to do this is to make a hole through the wall, and fasten a piece of board in front of it in a sloping manner, so as to give the air an upward direction. It is better to put "cheeks," as they are called, on the sides, for they serve not only to attach the sloping board to the wall, but prevent the air from falling out sideways into the room. This ventilator may be hidden by hanging a picture in front of it, and will cause no draught. I may state here that it is better, in a large room, to have two or more small ventilators, of any kind whatever, than one large one, and that no single inlet opening should be larger than a square foot. Openings of half that size are preferable. It is calculated that there should be 24 square inches of opening per head, so that a square foot would be sufficient for six persons. In such an opening as has been described, wooden or glass louvers may be placed.

The same end may be attained by making one of the upper panels of a door to open forward with hinges to a certain distance, or even, in some instances, by fixing it in this position. An obvious disadvantage, and one which always has to be considered in making openings through walls and doors, is that conversation which goes on in the room can be heard in the passage outside. Sherringham's valve is a modification of this plan, and can be fitted either into an outer wall or into one between the room and the passage or hall. It consists of a metal box to fit into the hole in the wall, with a heavy metal flap, which can swing forward, and is exactly balanced by a weight at the end of a string passing over a pulley, the weight acting as a handle, by means of which the ventilator can be opened or shut, or kept at any desired position. What has been said before applies to these ventilators; they should not be placed too near the ceiling, and this is the mistake that is generally made in fixing them. Stevens' drawer ventilator may also be mentioned here. The name almost describes it; it resembles a drawer, which is pulled out of the wall for a certain distance, and allows air to come into the room vertically, in several streams, between metal plates placed inside the drawer. Jennings' "inlet" consists of an opening through an outer wall into a chamber in which dust, etc., is deposited, and thence between louvers into the room. Here I may mention that it is sometimes advised to place perforated zinc or wire gauze outside the entrance to the ventilators, so as to prevent dust, coming into the room. This is not advisable, as the apertures get clogged up, and the entrance of air is much impeded. It is better to have an iron grating, which will prevent birds entering, and to employ other methods for preventing the entrance of dust, soot, etc. etc. Where this is considered necessary, the plan of passing air through cotton wool, which must be frequently changed, may be adopted.

Currall's ventilator for admitting air through the door is sometimes useful. It resembles his window ventilator almost exactly; a long slit is cut through the door, a perforated metal plate placed outside, and a flat plate fixed parallel to the door inside and in front of the slit, thus giving the air as it comes into the room an upward direction. An admirable plan for the admission of air into rooms is by means of vertical tubes —an old system, but one which has been brought into prominence of late years by Mr. Tobin. A horizontal aperture is made in the wall into the outer air just above the floor, and then a vertical pipe carried against the wall the hight of from four to five feet. The cold air is thus made to ascend like a fountain into the room. It does so in a compact column, which only perceptibly spreads after it has got some hight above the mouth of the tube. It then mixes with the warm air at the top of the room, producing no draught at all. In spite of the vertical hight through which air has to pass before it emerges into the room, a considerable amount of soot and dust of various kinds is brought into the room. This may be obviated by placing a little cotton wool in the interior of the tube. This, however, although a very efficient plan, has the serious disadvantage of impeding the current of air. A better plan is the one patented by the Sanitary Engineering and Ventilating Company; a tray containing water is placed in the horizontal aperture in the wall, the entering air being deflected on to the water by metal plates. The greater part of the dust is thus arrested by the water, which is changed as often as necessary. In warm weather ice may be placed in the trays. Another plan is to place in the vertical tube a long muslin bag with the pointed end upward, and kept in shape by wire rings; this provides a large filtering area, and offers very large resistance to the passage of air. This may be taken out and cleansed as often as necessary. Several contrivances have been devised for the admission of air close to the floor, just behind a perforated skirting board. Among these are Ellison's conical ventilator and Stevens' skirting board ventilator, in which metal caps are placed in front of the inlet openings, and so distribute the air that no draught is felt. I think, however, that it is only advisable to admit warmed air at a low level into rooms, but there is no reason why such openings should not be made high up in the rooms —behind cornices, for example. Pritchett's paving, made of agricultural pipes, may also be used for making walls and partitions, and is obviously applicable for ventilation purposes, whether used as inlet or outlet.

(*Continued Next Month.*)

A New Steam Yacht.

James Gordon Bennett has made a contract with Messrs. Ward, Stanton & Co., of Newburgh, N. Y., for the construction of an iron steam yacht. It is to be built of the best American iron, and is to be 141 feet long at the water line, 18 feet beam, and 10 feet deep. As the prime object is the attainment of a high rate of speed, the model is cut away to the extreme of sharpness at each end, and as a consequence the boilers and machinery have to be placed in the center of the boat to keep her trim. Instead of two engines, as is usual, she is to have three. They will be supplied with steam from two boilers of great strength, capable of resisting a pressure of 200 pounds to the square inch, the ordinary working pressure proposed being 120 pounds. The rig proposed for the yacht is also peculiar; it is styled by the builders a "felucca rig," being simply three masts, on each of which is to be set a triangular sail. The object of this is to avoid yards or gaffs aloft, and have as little resistance when going head to the wind, as possible. She will have two smoke-stacks, one from each boiler. She is to be heated throughout by steam. It was first proposed to place the saloons forward, but Mr. Bennett finally decided that it would be more ship-shape to have them aft. The main saloon will be on the lower deck, and will extend the whole width of the yacht, and be about 30 feet long. Forward of the saloon, on each side, are to be two large rooms for the owner and some favored guests, while there will be two smaller rooms for guests abaft the saloon. All of the rooms will be fitted with hot and cold water faucets, and will be upholstered and furnished in the most luxurious manner. It is proposed to light the yacht throughout with gas. Her propeller is to be of the sectional style—that is, instead of the blades and hub being cast together in one mass, the blades screw into the hub, thus obviating the necessity of getting an entirely new propeller if one or two blades break off.

The Starting of Horse Cars Made Easy.

We see by the daily papers that an invention which will be of some importance where tramways are in vogue, is about to be practically tried in London. It consists in the utilization of the power generated in stopping tram-cars for the purpose of starting them, and thus saving the extra exertions of the horses. The contrivance is a coiled spring, which is wound up by the stopping of the car, and which, when released, acts on the wheels so as to impart motion. It is stated, moreover, that it will act as an assistance to horses up steep grades, the power having been stored up in a preceding down grade and kept in the spring until its energy is required. If the mechanism is simple and cheap, it ought to be of great saving in the wear and tear of horse power.

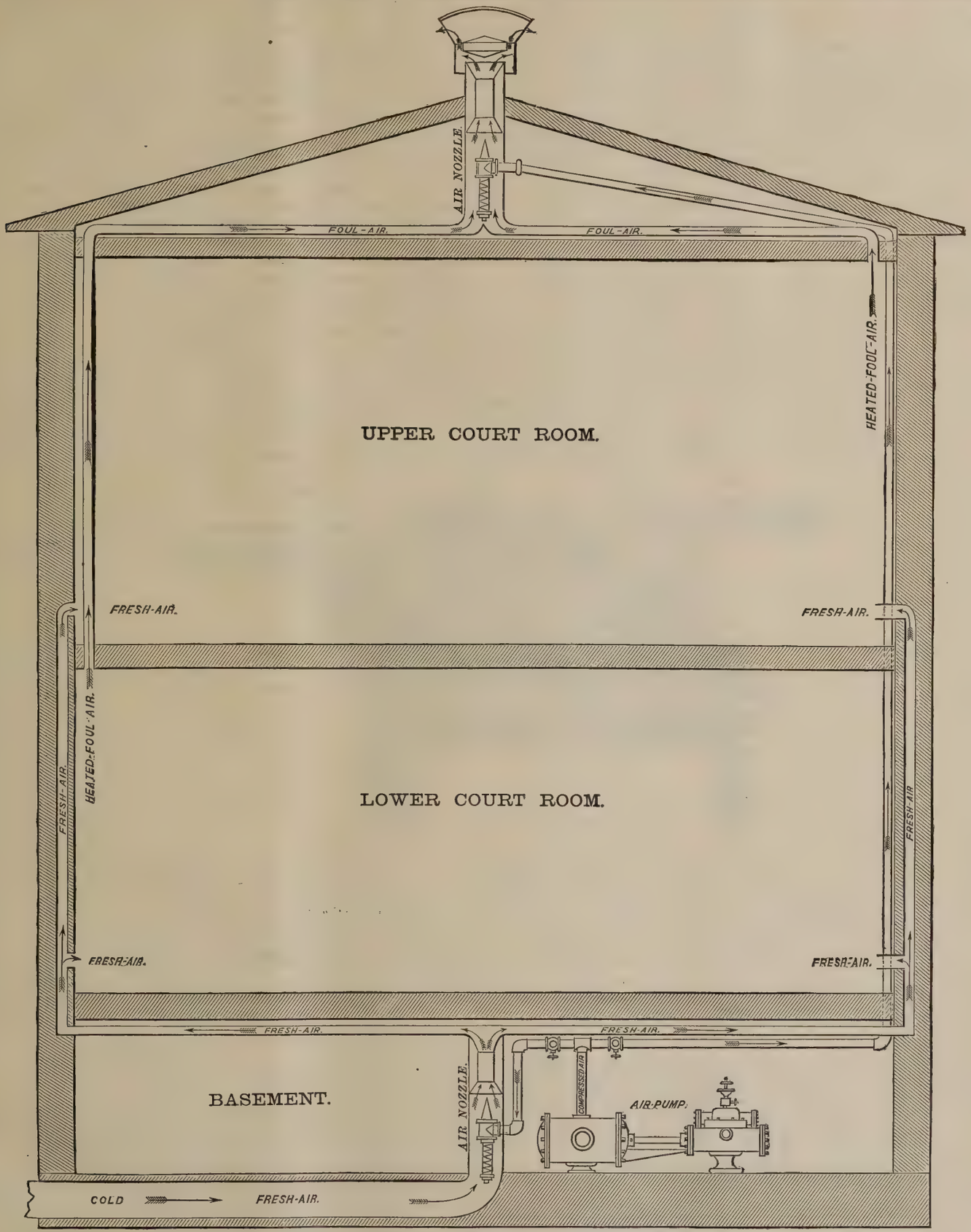
In connection with the above we would state that models of such contrivances were on exhibition at several of the fairs of the American Institute years ago, and that more than one United States patent has been granted for this and similar devices; but thus far they have never been introduced, experience having proved that a great deal is added to the dead weight of a car when a spring of sufficient size is added to store up any practically useful amount of power. Half a ton of steel is scarcely sufficient to store up one horse-power during the period of one minute.

Important Reform in Ventilating Apparatus.

It is with feelings of the greatest gratification that we report the results of a critical examination, to which we recently submitted the new method of ventilation, invented and patented by Mr. D. C. Green. We saw the complete apparatus in operation at the office of the D. C. Green Ventilating Co., 88 Liberty street, New York, and found that it operates on the principle of an injector, in which a blast escaping from a new and novel automatic air nozzle, consisting of a narrow circular slit, and blowing into a wide funnel-shaped pipe of some ten times the diameter of the circular slit, carries from thirty to forty times as much air with it as is projected from the nozzle. The motive power is a steam air compressor, which furnishes a comparatively small supply of compressed air to the nozzle, of which the degree of compression is automatically regulated, so that whether larger or smaller quantities of air pass the nozzle, it cannot exceed or fall below certain limits of pressure, which have been determined by careful experiments as the most economical in their results. The air ejected from the nozzle, with some thirty or forty times its bulk of other air, is carried through proper channels to the rooms to be ventilated, of which the section on the opposite page gives an idea.

In the basement the air pump is seen, which can carry the compressed air by tubes to several nozzles, each placed in its proper funnel, and carrying with the small supply of its own compressed air, a larger supply of common fresh air. In the engraving only two such nozzles are represented, one at the left of the air pump, driving the cold fresh air upward through ordinary channels to different air registers near the floors of the rooms in the different stories, and the other nozzle in the attic of the building driving the air out over the roof, thus establishing a powerful upward suction, removing the foul air from the upper portions of the rooms through the channels intended for that purpose. A simple inspection of the engraving gives so clear an idea that further description may be dispensed with.

The great advantages of this method become evident by remembering that it makes it entirely unnecessary



THE D. C. GREEN SYSTEM OF VENTILATION.

to construct for ventilation wide air channels for the whole distance from the ventilating power to the place to be ventilated. This is absolutely necessary when fan wheels are used, or other contrivances propelling all the air used for ventilation, resulting in very little pressure and moderate velocity. By substituting a very small amount of air, only two or three per cent of the air we wish to propel, giving it a higher pressure and propelling it at a greater velocity, we may convey this air in tubes of one-tenth, or less, the diameter, thus reducing 20-inch pipes to 2-inch tubing. This tubing we may lead to the place to be ventilated, and there blow the air through the proper nozzle into the funnel-shaped opening, and the two per cent of compressed air will carry ninety-eight per cent of ordinary fresh air into a building as effectively as a fan wheel would carry it through a pipe ten times the diameter.

It is evident that this system is invaluable on board ships, especially ocean steamers, as a nozzle may be pointed downward in any shaft intended to carry fresh air to the boiler room and other rooms, the nozzle being connected by a 2-inch pipe to the air pump, the fresh air surrounding the nozzle will then be carried down as soon as the pump is started, and every place may be thus ventilated, even such as with the old method could not be reached by the ordinary large ventilating shafts for want of room to place them.

Of course we were not surprised when informed that this invention had attracted the attention of those in authority in the United States Navy. It bids fair to be introduced on board all our men-of-war, and we congratulate the inventor upon his success.

Latest Improvements in the Spectroscope.

There is perhaps no more fascinating branch of physical science than spectroscopy; it is scarcely twenty-five years old, and has already been the means of determining the chemical composition of other worlds than ours, not only utterly inaccessible to us, but of which the light passes through immeasurable distances before it reaches us; while here on earth it has discovered elements of which, without the spectroscope, we would not even have suspected the existence. The next problem which this wonderful instrument appears destined to solve, is the secret of the ultimate constitution of matter.

It is not surprising then that such elaborate efforts are made to perfect this magnificent instrument for the decomposition of all kinds of light. The principal aim lately has been to disperse the series of images of the slit, which the prismatic refraction produces, over the greatest space possible. The more the spectrum is stretched out the better are the dark and the luminous lines separated; or, to use a poetical expression of the French savant Adrian Guébhard, "we bring out the brilliant notes of the luminous symphony."

The trouble, however, is that if we stretch the spectroscope out so much, we lose brightness in proportion, which loss is made greater by numerous irregular reflections and absorptions, resulting from the use of a great number of refracting prisms. This is even the case when the ray is reflected back in its own path, and thus far little success has crowned the attempts to overcome the difficulty.

As a result of calculations and experiments, M. Thollon, of Paris, has succeeded in overcoming in a happy manner the difficulties referred to, in an instrument furnished with an extreme perfection and finish by M. Laurent. The prisms are cells containing carbon sulphid, of which the faces through which the light enters are formed by plates of crown glass, also cut as prisms with a small angle. We will not criticise this complex system, nor the reasons for which it was adopted, but simply state that the result was so magnificent as to be almost incredible, but after all, perfectly conforming to the expectations of the inventor. Three of these prisms through which the light was passed twice gave a dispersion equal to thirty-one ordinary prisms of 60° made of glass with an index of refraction of 1.63.

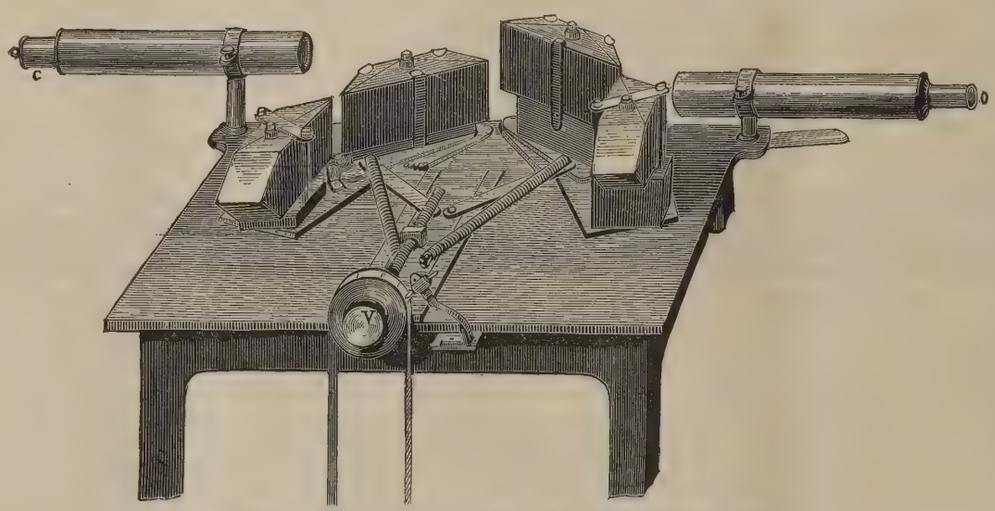


Fig. 1.—THOLLON'S COMPOUND SPECTROSCOPE.

M. Thollon uses two large prisms A A′, and two small ones B B′; to the latter are cemented two ordinary prisms P P′ with total reflections. Fig. 1 gives a perspective view of the whole apparatus, while Fig 2 (on the opposite page) shows the course of the rays through the prisms. It will be seen in Fig. 1 that the ray of light enters the collimator C, is refracted by passing through the upper part of the prism A, Fig. 2, and of the second prism B, from which it arrives in the prism P, which totally reflects the ray and sends it back through the lower part of the prism B; from this it passes through the lower part of the prism A, and from here through the upper parts of the prisms A′ and B′, which are placed on a little lower level than A and B; the ray reflects again in the prism P, and, returning through the lower parts of B′ and A′, it emerges in the same direction as it came in, with a simple displacement in hight, and then enters the telescope, Fig. 1, to be seen at O.

The four prismatic glass cells are symmetrically placed, only on a different level; they are supported by pivoted stands, to which a system of levers is attached, very ingeniously contrived, so that by the turning of the screw V, Fig. 1, the prisms are all harmoniously turned, so as to set them for producing refractions at the minimum deviation of the line seen on the wire across the field of the telescope. The head of this screw carries a strip of paper similar to that used in telegraphing, the ends of which are stuck together, so as to form a belt; this paper belt hangs down, and at its lower portion is a pulley equal to the head of the screw, the weight of which keeps the paper stretched. A lead pencil is attached to a spring M, and may be made to draw a line across this strip of paper every time the screw head V is at rest, as seen at the right side of V. In this way a continuous registering of the lines may be made while they are passing the field of the telescope O, and it will be easy, as soon as coincidences have been noticed, with the interference spectrum of Amströnng, for instance, to calculate by interpolation the length of the corresponding intermediate waves. This is a great advantage, for, besides the number of vibrations, there is nothing correct in the study of the spectrum, and it has been from want of such registering contrivances that many beautiful researches upon the heavenly and terrestrial bodies have remained without direct results, or given rise to uncertain deductions.

An apparatus capable of revising and correcting the fundamental tables of Amströnng, and of doubling the number of known lines recorded by the eminent Danish investigator, deserves great praise. But this is not all. This instrument of Thollon is so sensitive that it is quite easy to prove the displacement of the lines by the motion of the revolution of the sun around its own axis, when the light of the two equatorial edges of the sun are brought side by side and their identical lines observed. Fizeau had announced that he found in the yellow lines about one-150th of displacement of the lines, and as here the double sodium lines D_1 D_2, Fig. 3, appear at the unusually great distance of half an inch, it is easy to perceive the displacement of one-50th part of an inch, due to the slight difference in velocity of 4 kilometers upon several million. And why may not M. Thollon settle, with his new spectroscope, the famous disagreement between M. Taye and Father Secchi concerning the ascending and descending currents in the solar spots?

Evidently this refined instrument settles those authors who, without consideration for exact research, predict an indefinite multiplication of lines in the spectrum, and pretend that they have seen sixty of them between the double sodium lines D_1 D_2. M. Thollon, after counting carefully all he saw, found twelve of them, but at the same time he found new rays, though so fine that he could not well submit them to the usual method of localization. He found a great number of lines which became double by his instrument, such as the lines b_3 b_4, Fig. 4, of the nickel and of the manganese. There are several others behaving in the same way, and it is singular that in the lines belonging to two metals in common this doubling has been mostly observed. This is an argument in favor of the hypothesis recently propounded by Lockyer.

Among the new lines are, no doubt, those of gases, and also those of metals, but so fine as thus far to have escaped notice. Is there actually oxygen in the sun, as recently Dr. Henry Draper has attempted to prove? Are there not also gold and other metals there? Is there perhaps ozone in the high regions, to which we must attribute the striking analogy between the telluric groups A and B, which are always seen together under the same circumstances, and which Amströnng saw in the absence of all moisture at a temperature of 2° Fah.? These questions, and several others, will be answered as soon as M. Thollon applies powerful electricity to the substances he submits to his instrument. This would be especially available for the violet and ultra violet rays when the lines become so indistinct, diffused, and dark as to be difficult to localize. It is objected that spectroscopes working by refraction, stretch the rays too much in this part of the spectrum. But it is a fact that those acting by diffraction do the same in the violet rays, and our hope is in strong illumination by electric light, which will certainly develop, with the spectroscope, an amount of knowledge we do not yet dream of.

While doing justice to M. Thollon's merits, we cannot abstain from the critical remark that liquid prisms are objectionable by reason of the variable density of the liquids and consequent possible motion of the particles, which can never give the well defined lines obtained by solid prisms. We should prefer the same arrangement by prisms of solid flint glass, of great dispersive quality, such as obtained by the addition of boron.

Figs. 3 and 4 are intended to show the superiority of M. Thollon's apparatus; the lower part, marked 2, represents the lines as recorded by Amströnng, while the upper portion, marked 1, shows the lines as seen by the spectroscope of M. Thollon. The figures speak for themselves; we will only remark that it is difficult to give in print a correct idea of the real appearance—it is simply impossible to do a solar spectrum justice. The engraver, however, has done the best his art allows.

The Steel Age.

Every day steel is supplanting iron for some one of the numerous purposes to which that metal has hitherto been applied. Iron rails are already replaced, or soon will be, by steel rails on every considerable railway in the land. In a paper read before the Iron and Steel Institute, it was stated that many of the British lines could not have paid more than half the dividends they now make if it had not been for the development of steel rails and steel tires. The opinion is gaining ground among ship builders that a framework of steel for vessels would be superior to iron, being a lighter material in proportion to its strength. It is evident that the coming century is to be an age of steel. Upon the perfection of that metal, and its adaptability to the various uses to which it may be put, the safety of the modern traveller must largely depend. And whether he is rushing over the surface of the earth on an express train at the rate of fifty miles an hour, or driving three hundred and fifty miles a day through the ocean

on a transatlantic steamer, he wants to rest assured that science has done all it can to make his journey safe.

The above remarks were suggested by the opinion expressed recently at the Iron and Steel Institute in Liverpool, that the tests required at present for steel were too stringent and severe. But it was answered that the traveller would not feel as safe as he does were the tests of steel diminished in severity. Criticism was chiefly directed to the tests applied by the Lloyds and the Admiralty to steel used in ship-building only; but it is probable that if stringency is relaxed in one direction, it will be in all. The argument was that although steel makes a better framework for ships than iron, it will not be employed at present, because it must undergo tests proportionately much more severe than those to which iron is subjected—in other words, the

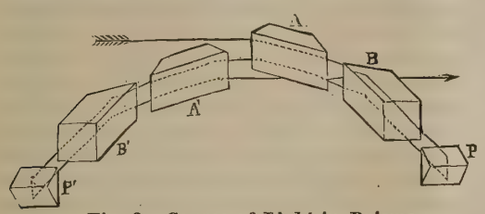


Fig. 2.—Course of Light in Prisms.

manufacturers, or some of them, contend that under much lighter tests than those now required steel framework would be quite as strong as the iron framework which the authorities constantly approve. But this may be an argument against the sufficiency of the iron tests rather than against the stringency of the steel tests.

Whether it is or not, however, Dr. Siemens, than whom no man ought to be more competent to speak on the subject, pointed out a difference between iron and steel which appears to justify the maintenance of the severest tests. Iron, he said, always holds together, except when fractured by a blow under peculiar circumstances; its tendency is to hold together when struck or strained, whether it is of good or poor quality. But this is not the case with all steel. The best steel, it is true, will bend like leather rather than break; but anything inferior to that quality is far more liable to disastrous fracture than iron. Hence, said Dr. Siemens, do not diminish the tests of steel, but rather increase their severity.

Practically, this positive expression of opinion from so high an authority settles the question for the time being. We do not mean that there was no dissension from the views of Dr. Siemens, but none of the steel tests under consideration are likely to be relaxed in opposition to his emphatic advice. As the maintenance of a high standard of excellence in Great Britain is conducive to the maintenance of a like standard in this country, we regard this result with content.

Test of the East River Bridge Cables.

The East River bridge cables have just been tested by a machine which is the most elaborate and perfect of its kind in the world. It is the one planted on the government grounds at the Watertown (Mass.) Arsenal, designed by Mr. A. H. Emery, and is indeed a marvel of skilled construction, for it shows how many ounces are needed to break a piece of thread, and how many tons to fracture a steel beam. The apparatus is microscopic in accuracy, inasmuch as it registers, in a breaking weight of a million pounds, within one pound of the mass needed.

This was the machine selected to test the suspending cables, and Messrs. Wm. H. Payne and Isaac Newton, engineers connected with the Brooklyn bridge, spent four days in the tests at the arsenal, which is under the charge of Col. T. T. S. Laidley, of the Ordnance Corps. Instead of using small sections of the suspending cables, they took lengths that would make the results decisive. Not to go into technicalities, the tests were entirely satisfactory, and showed that the precautions taken in putting together the parts were ample for their purpose. The suspending cables were found by the engineers to possess a strength much greater than is required to resist the strain that will be put upon them in actual use. A thought suggested by this test is that it is a matter of regret that a machine so useful should be left on one side of the central lines of iron and steel construction. It cost the government nearly $100,000, and it would be well to have it used freely by the people.

Improved Lubricant.

According to reports, a certain Senor Uncity, has, by means of chemical treatment of common grease, changed its qualities so as to make it a very much better lubricating material, and at the same time an anti-incrustator for steam boilers. He lately made an experiment with it before the Exhibition of Applied Science in Paris, and the results, as reported by *Iron*, are given here for what they are worth. That journal says:

"Two open boilers, made of tinned sheet iron, were put upon two coke furnaces of equal intensity, but the bottom of one of the boilers was coated with the grease outside, so as to be in immediate contact with the flame, whereas the other was not so coated. The former began to give off steam in a quarter of an hour, and the latter not until half an hour had elapsed; whence it may be inferred that the grease increases the conductibility of the metal, so that with a given quantity of fuel more water is turned into steam. A brass lubricator, of cylindrical form, filled with the grease, was then plunged into the water in the coated boiler, and almost immediately minute particles of the lubricant began to issue from a small hole in one end, rise to the surface, and gradually spread themselves over it. This was to show the application to the interior of a steam boiler for preventing incrustations, 3 grammes (about 1½ drachms) being used for each horse-power. The grease is also carried along by the steam into the cylinders, rendering any other lubrication unnecessary. Notwithstanding the cooling effect produced by the lubricator, a large body in proportion, the water in the coated boiler bubbled violently in an hour from the time of its being placed in the fire, whereas the one not coated did not boil in an hour and a half, when the experiment stopped. A portion of the grease was wiped off from the bottom of the coated boiler and thrown on to the fire, when it immediately flared and was consumed. The tin bottom was as bright as before, but that of the other boiler gave evidence of the action of the fire. This was to show, on a small scale, that boiler plates exposed to the action of fire do not become burnt. And, indeed, this fact follows as a natural consequence of the other point established, namely, the increased conductibility given to the plates. Those who witnessed the demonstration were most astonished to see that a stick dipped in the grease made marks on the hot sides of the boiler and furnace as distinct as lines with a drawing-pen, and which did not run together, as they would have done if made with ordinary grease. So far the experiments have been most conclusive, fully bearing out the official certificate of the Spanish government; and it will be interesting to watch the result of a continued application to steam boilers on the scale of actual practice."

We feel obliged to add that we consider these results so wonderful, that we conscientiously repeat that we give them for what they are worth, and are far from vouching for their truthfulness.

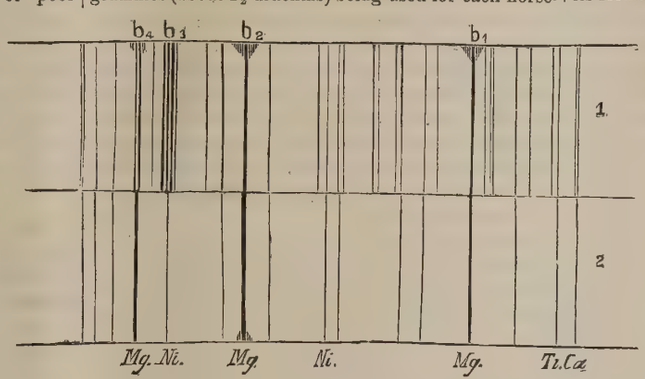


Fig. 4.—Details of Spectral Lines.

The Influence of Silicon on Steel.

An interesting experiment, which shows the effect of silicon in preventing the reduction of phosphorus

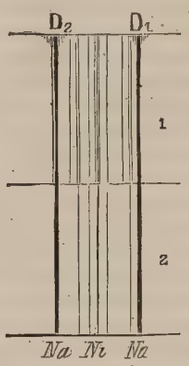


Fig. 3.—Lines Between the Double D Line.

in acid in the cinder of an open-hearth furnace, is given by M. A. Pourcel, of Terrenoire, France. A 3-ton charge, containing 250 per cent of carbon and 0.50 per cent of phosphorus was melted in an open-hearth furnace. As soon as the charge was thoroughly melted, the slag which covered the metal was removed, and the surface of the bath laid bare. The gas was then shut off, and the hot air alone allowed to pass through the furnace. At the end of 15 minutes a black slag had formed on the surface of the bath, and during its formation jets of carbonic oxid gas were constantly rising from the metal. This fact should be noticed. Samples of metal and slag were then taken, and the gas again let on to re-heat the bath. The phosphorus was estimated in the metal and slag, and the percentage in the former was found constant, namely, 50 per cent, the slag showing no traces of this element. When the bath had been re-heated the slag was again removed, the gas shut off, and a second refining effected, as before, but instead of allowing carbonic oxid to form, an addition was made of a certain quantity of silicid of iron manganese, containing 20 per cent of manganese and 10 of silicon, which completely prevented the disengagement of carbonic oxid gas. After a quarter of an hour the jets of carbonic oxid again appeared, and a sample of the metal was taken before the gas was turned on, and the slag formed during the passage of the air only was removed. The metal now yielded, on analysis, only 0.35 per cent of phosphorus, and a very appreciable amount was found in the slag, although it was not estimated quantitively. The experiment was repeated, but instead of taking samples immediately on the reappearance of the jets of carbonic oxid after the action of the silicid, and instead of clearing away the slag formed during this period, which slag contained the phosphorus that had been scorified, samples were not taken until fifteen minutes after the gas was turned on and boiling of the bath had recommenced. It was now found that the phosphorus had disappeared entirely from the slag, and had been reabsorbed by the metal, which yielded, on analysis, its original contents, namely, 0.50 per cent. Thus, under the oxidizing action of a current of hot air, phosphid of iron is scorified, when the reducing action of carbonic oxid is obviated by the addition of a metallic silicid to the bath. By making three successive calcinations, each of from ten to twenty minutes' duration, and under the above

mentioned conditions, M. Pourcel succeeded in reducing the phosphorus from 0.5 to 0.24 per cent.

Scientific.

MECHANICAL PRODUCTION OF COLD.—The production of cold by means of mechanical operations, as distinguished from cooling by radiation or conduction, has never been accomplished in so thoroughly practical and satisfactory a manner as in the great paraffin oil works at Bathgate, England. In order to extract the solid paraffin, it is necessary to cool down all that portion of the crude oil to a temperature of 35° to 40° F., so as to cause the paraffin to crystallize. When the works were in their infancy, this was accomplished by storing the oil in summer and exposing it in flat dishes to the cold in winter. As the works increased, it became necessary to devise means for accomplishing this result at all times during the year. The Harrison ether machine did good service, but it was found to be too small. Mr. A. C. Kirk, the engineer of the works, after learning of the ice machine of Dr. Gorrie, which had succeeded in Florida but failed in London, decided to follow methods similar to those adopted in that machine. The simple plan of compressing air into a receiver by means of a compressing pump, was first tried; the compressed air being then allowed to expand, and in its expansion do the work of driving a steam engine, was expected to be ejected from the cylinder of the latter at a much lower temperature. But the condensed air entered the cylinder at the temperature of the surrounding atmosphere, and neutralized much of the cooling effect of the preceding stroke. There was also moisture in the air, to remove which no precaution had been taken; and other mechanical difficulties caused this experiment to be abandoned. Attention was then turned to an air engine of a form allied to Stirling's, and the experiment under new arrangements having succeeded, Mr. Kirk constructed a large machine, which has been continually at work since 1864, and fully accomplishes all that can be desired. This, the first Bathgate machine, is usually worked at from 100 to 120 pounds to the square inch, the efficiency and capacity for work increasing with augmented pressure. The air is drawn through chlorid of calcium in order to dry it, for if the air be damp, moisture is deposited, in the form of snow, in the upper parts of the generator. As far as possible, the air is also cooled before being compressed.

A modification of this machine, adapted to the cooling of large quantities of water, or for ice-making, has also been constructed by Mr. Kirk for the use of the Oak Bank Oil Company, and has been at work since 1872, with a success equal to that of the original Bathgate machine. As an average sample of the work done by the Bathgate dry-air machine in 1864, Mr. Kirk, after giving the dimensions of the cylinders, etc., states that 6.7 gallons of brine are cooled per minute, from 32° down to 23½° Fah. The wet-air machine at Oak Bank cools 20.6 gallons of fresh water per minute, from a temperature of 61° down to 47°.

THE LICK OBSERVATORY.—The *Science News*, speaking of the above observatory, points out the value of the California climate for favorable astronomical observations. It says: "During the last four years very little has been heard of the observatory to be built in California, from the gift of Mr. James Lick, and the public has very generally supposed nothing would come of the project. But there are now signs of a renewed activity on the part of the trustees, and evidence of an intention to carry the project through without further delay. Last August, Mr. S. W. Burnham, of Chicago, the well-known observer of double stars, was invited to spend a month or two on Mount Hamilton, with his telescope, in order to test the suitability of the mountain as a site for the proposed observatory. His reports were so favorable that Prof. Newcomb, on whose recommendation he was chosen for the work, visited the place himself in September. Both these gentlemen speak in the highest terms of the excellence of the astronomical conditions. Not only is almost every night perfectly clear, but, according to Mr. Burnham, bad seeing is almost unknown. Every night is such a one as he would consider superb at Chicago, and would only be met with two or three times a year. He discovered during his stay a number of new double stars, in portions of the sky which are further south than can be thoroughly examined in the comparatively bad atmosphere of stations this side of the Mississippi.

The result of this exploration will give both the trustees and the public a new interest in the project, and it is supposed will lead the former to push the work on as rapidly as possible. If, as both the astronomers who have examined the site seem to suppose, its atmosphere is finer than that of any existing observatory, the result will be that the most powerful telescope in the world will be under the finest sky for supplying its utmost capacity.

PERFORATING GLASS WITH THE ELECTRIC SPARK.—If the glass intended for the perforation is very thick, it is customary to imbed one of the electrodes in a mass of melted resin, placed on the surface of the glass. This operation requires heat, and is tedious, not to speak of the trouble of clearing the glass afterward of the resin, so as to see the perforation.

M. Fages, architect, of Narbonne, France, publishes in the French papers an improved method, which consists in the use of a small, simple apparatus that may serve for any number of experiments. It consists, first, of a rectangular disk of hard rubber 5 by 7 inches, and second, a brass wire, of which the point passes through the rubber and comes flush with the other side, and is held in place by friction or a screw-thread. A plate of this size is necessary for a Ruhmkorff coil, or its equivalent, giving sparks 5 inches long; larger machines require larger plates of rubber.

In order to use this instrument, it is placed horizontally upon a support, with the brass wire below; the latter is then connected with the electric machine, while a few drops of olive oil are placed on top over the place where the brass point reaches through the rubber; the glass plate is then laid on top, taking care not to have any air bubbles between the oil, so that the latter entirely fulfills its purpose, which is to isolate the point. (Any other well isolating oil will do as well). Then the other electrode is placed on top of the glass, and the spark passed. If the glass is slightly displaced sideways, it is easy to perforate it in several places close together.

The only condition necessary to observe in this experiment, is that the plate of hard rubber be large enough and perfectly flat, so as to fit well against the glass plate, making it impossible for the spark to fly off on a sideward path.

SUBDIVISION OF ELECTRIC LIGHT.—It is reported from San Francisco, Cal., that the Molera & Cebrian system of subdividing and distributing electric light is a great success. The method consists in the use of a system of lenses and reflecting mirrors; the first make the rays of light parallel, when the mirrors reflect them and conduct them to any desired distance, without weakening them in intensity, except to a very small degree. On reaching the place to be illuminated, the rays of the parallel beam are made divergent by a distributing lens or reflector. It is claimed that in this way the light of a single electric lamp may be distributed and divided through all the rooms of a hotel without any material loss of intensity. The supply of course is also regulated and controlled by reflectors, so that the light in any of the rooms may be increased or diminished at will.

It is evident that this method dispenses with the use of conducting wires, while it is claimed that the total cost of such a method of illumination is less than that required for gas works. We should not be surprised if this method were found to be more practical and economical than the transportation of the electric current through wires, as the sending of a beam of light through the air is one of the most inexpensive things that can be done; the only problem is a proper adjustment of the foci of the lenses used, so as to prevent a spreading out of the beams, and convey them as purely parallel rays. In this condition they may be sent hundreds of feet, and are not subject to the law that the intensity is inversely proportional to the square of the distance, but the light will, at the distance of say 500 feet, have lost little of its intensity, while electricity, passing through wires, would certainly have to overcome more resistance and loss, than light experiences in passing through air.

MORE DOMESTIC USES FOR ELECTRICITY.—Some new applications of electricity are being introduced by the Boston Electric Company. They have some of them on exhibition in the Rialto Building, 131 Devonshire street, Boston. They certainly are some of the most surprising as well as convenient and economical electric adaptations. By means of a Le Clanche battery, and a system of wires and buttons, a gentleman on entering his house can turn on and light the gas in the dark entry, light still another in the sitting-room, upper entry or chamber, and when comfortably seated, extinguish one or all without rising or fear of failure, leakage or loss of gas. Nay, more, he may have his windows so fixed that the entrance of a burglar will quietly awake him and light the burners in his room, so that he can secure his pistol and go softly down to suddenly dazzle and secure the intruder by the use of the buttons controlling the light of the room entered, or he may simply flood the room with light and frighten off the intruder with the burglar alarm. The merchant can from his desk control any burner on the floor he occupies, or light a dark cellar or loft before stumbling through its dark recesses, and can control show-rooms or workshops only occasionally entered. The lady in her boudoir, the student at his desk, the sick left alone and helpless, can add to or decrease the light in their several apartments, without moving from chair or couch, with less risk of breakage and greater certainty of the right degree of illumination.

In mills, manufactories, public halls, stores, and private dwellings, the saving in breakage, gas, insurance, and the casualties arising from fire will generally make the outlay a profitable investment. By attaching a fire alarm, the lighting of the gas can be made to indicate the increase of temperature in any apartment, and so give warning in another way.

PETROLEUM AS FUEL IN METALLURGY.—The great advantage in using petroleum as fuel, is that in a well arranged furnace the supply and consequent degree of heat is under perfect control, while for metallurgical purposes a second advantage is the freedom from impurities injurious to the metals. It is now being applied to the manufacture of iron, and Dr. C. T. Eames has a petroleum iron furnace in successful operation at Titusville, Pa. He evaporates the petroleum by superheated steam, which blows into a chamber in which the oil is trickling down over a series of shelves. The evaporated petroleum is then driven into the combustion chamber, from which the air blasts drive it into the furnaces. Here the iron is exposed to a quicker, greater and purer heat than can be obtained from coal, wherefore the quality of the iron thus obtained is uniform, and of a much higher grade than can be made by coal fuel.

TECHNICAL EDUCATION.—The *Revue Industrielle* states that it was feared that French artisans connected with many of the higher branches of skilled industry no longer possessed that perfect mastery over their several handicrafts which, up to recent times, had honorably distinguished them and won for various classes of French articles a high reputation abroad as well as at home. With a view to effect improvement, the Minister of Education has ordered that at the Apprentices' School at La Villette, Paris, a number of youths, after passing through the ordinary course, should henceforth devote three years additional to the study of mechan-

ism, especially to the more delicate kinds of mechanical work. It is also intended to open a similar establishment in another quarter of Paris. The municipal authorities of the French capital are also taking steps to encourage the acquisition of mechanical skill by young workmen, and have just granted to M. Bouccart, a noted mechanician, who already had six apprentices, a subvention of 4,000 francs, on condition of his taking in ten additional apprentices, who are to be under the supervision of the city authorities for three years.

Deep-Sea Soundings by Photography.—Dr. Neumayer has presented to the Geographical Society of Berlin a remarkable photographic apparatus for determining the temperature and current-direction at any particular depth in the ocean. It consists of a brass box hermetically closed, and having attached to it an apparatus resembling a vane or rudder. Within this box a thermometer and a magnetic needle are contained, behind each of which is placed sensitive photographic paper, and in front of each of which is a small nitrogen vacuum tube. The box also contains a small induction coil. When the apparatus is lowered to the required depth, the rudder causes it to take a direction parallel to the current there existing, and hence a definite direction with reference to the needle within. The thermometer soon acquires the temperature of the water outside, and becomes stationary. At this instant an electric current is sent to the box, which, by means of the induction coil inside, lights up the little nitrogen tube, the violet light of which, photographically very intense, prints, in about three minutes, the position of the needle and the hight of the mercury column upon the prepared paper. The current is then intermitted, the apparatus raised, the photographic tracing fixed, examined, and placed upon record.

Physical Properties of Soil.—Practical scientists have begun to recognize more and more the fact that the chemical constituents of the soil are not the only agents that influence the life and growth of plants, but that the physical characteristics have an equal, and perhaps even greater influence. During the last few years agricultural chemistry has busied itself largely with building up a new department of science—that of the physical characteristics of the soil. This new study, in connection with agricultural chemistry, promises to practical scientists a true conception of the soil as the home of plants, and in this way to clear up many phenomena of plant life thus far unexplained.

Next to the texture of the soil, which is an exclusively physical characteristic, there is water and heat, which have a great deal to do with the problem of how much a given soil will yield—in fact, perhaps more than the amount of plant-food the soil contains, and the proof is the great difference in productiveness in different seasons; dry or cold seasons are enough to make an otherwise rich soil little productive.

Animal Germs in the Air.—M. Miquel, by a newly contrived apparatus, which he calls an Aeroscope, has collected from 500 to 120,000 organized cells per cubic meter of air. He finds that the number of microbiæ in the air is small in winter, augments rapidly in the spring, is stationary in summer, and diminishes in autumn. Rain increases the number surprisingly; when, for instance, the instrument records from 5,000 to 10,000 germs in one day, rain sets in, and the next day more than 100,000 are recorded. These cells are mostly spores of mucelinæ, then fructifications of microscopic fungi, pollen of variable sizes and colors, but especially green microscopic algæ, of which large quantities are often transported in the air.

Transmission of Sound in very Cold Air.—It has been found that in the Arctic regions, when the thermometer is below zero, persons can converse more than a mile distant. Dr. Jamison asserts that he heard every word of a sermon at a distance of two miles. This is due to the fact that great cold increases the elasticity of the air, making it, of course, a better conductor; while heat, diminishing the same, decreases its power of conducting sound.

How Much a Billion is.

Henry Bessemer contributed to the London *Times* recently a very interesting communication on the significance of a billion. He says:

"It would be curious to know how many of your readers have brought fully home to their inner consciousness the real meaning of that little word "billion," which we have seen of late so glibly used in your columns. There are, indeed, few intellects that can fairly grasp and digest it as a whole; and there are, doubtless, many thousands who cannot appreciate its true work, even when reduced to fragments for more easy assimilation. Its arithmetical symbol is simple and without much pretension; there are no large figures—just a modest 1, followed by a dozen ciphers, and that is all.

"Let us briefly take a glance at it as a measure of time, distance and weight. As a measure of time, I would take one second as the unit, and carry myself in thought through the lapse of ages back to the first day of the year 1 of our era, remembering that in each of those years we have 365 days, and in every day just 86,400 seconds of time. Hence, in returning in thought back again to the year of grace 1878, one might have supposed that a billion of seconds had long since elapsed; but this is not so. We have not even passed one-16th of that number in all these long eventful years, for it takes just 31,687 years, 17 days, 22 hours, 45 minutes, and 5 seconds to constitute a billion of seconds of time.

"It is no easy matter to bring under the cognizance of the human eye a billion objects of any kind. Let us try in imagination to arrange this number for inspection, and for this purpose I would select a sovereign as a familiar object. Let us put one on the ground and pile upon it as many as will reach 20 feet in hight; then let us place numbers of similar columns in close contact, forming a straight line, and making a sort of wall 20 feet high, showing only the thin edges of the coin. Imagine two such walls running parallel to each other and forming, as it were, a long street. We must then keep on extending these walls for miles—nay, hundreds of miles, and still we shall be far short of the required number. And it is not until we have extended our imaginary street to a distance of 2,386½ miles that we shall have presented for inspection our one billion of coin.

"Or in lieu of this arrangement, we may place them flat upon the ground, forming one continuous line like a golden chain, with every link in close contact. But to do this we must pass over land and sea, mountain and valley, desert and plain, crossing the equator, and returning around the southern hemisphere through the trackless ocean, retrace our way again across the equator, then still on and on, until we again arrive at our starting point; and when we have thus passed a golden chain around the huge bulk of the earth, we shall be but at the beginning of our task. We must drag this imaginary chain no less than 763 times around the globe. If we can further imagine all these rows of links laid closely side by side, and every one in contact with its neighbor, we shall have formed a golden band around the globe just 52 feet 6 inches wide; and this will represent our one billion of coins. Such a chain, if laid in a straight line, would reach a fraction over 18,328,445 miles, the weight of which, if estimated at ¼ ounce each sovereign, would be 6,975,447 tons, and would require for their transport no less than 2,325 ships, each with a full cargo of 3,000 tons. Even then there would be a residue of 447 tons, representing 64,081,920 sovereigns.

"For a measure of hight let us take a much smaller unit as our measuring rod. The thin sheets of paper on which these lines are printed, if laid out flat and firmly pressed together as in a well bound book, would represent a measure of about 1.333d of an inch in thickness. Let us see how high a dense pile formed by a billion of these thin paper leaves would reach. We must, in imagination, pile them vertically upward, by degrees reaching to the hight of our tallest spires; and, passing these, the pile must still grow higher, topping the Alps and the Andes and the highest peaks of the Himalayas, and shooting up from thence through the fleecy clouds, pass beyond the confines of our attenuated atmosphere, and leap up into the blue ether with which the universe is filled, standing proudly up far beyond the reach of terrestrial things; still pile on your thousands and millions of thin leaves, for we are only beginning to rear the mighty mass. Add millions on millions of sheets, and thousands of miles of these, and still the number will lack its due amount. Let us pause to look at the neat ploughed edges of the book before us. See how closely lie those thin flakes of paper, how many there are in the mere width of a span, and then turn our eyes in imagination upward to our mighty column of accumulated sheets. It now contains its appointed number, and our billion sheets of the *Times* superimposed upon each other, and pressed into a compact mass, has reached an altitude of 47,348 miles—one-fifth the distance of the moon!"

Live (?) Animals without Heads.

Some editors are either very credulous themselves, or think their readers will believe anything, however absurd it may be. We find in a recent issue of the *Cincinnati Commercial* an article entitled, "A Rooster Living with its Head Cut Off," of which the following is an abstract:

"Martin Ryan [full address given] has a curiosity in the fowl kingdom. He cut the heads off of two roosters, and expected that the fowl would be dead in a few minutes. What was his surprise, after untying the strings from the legs an hour and a half afterward, to see one of them get up and jump around. It was taken into the house, and ten hours after the head was cut off it attempted to crow. He has preserved this curiosity, and it has been seen by several hundreds of people. It is now fed by means of a spoon, and the food is poured down through the opening. It does not appear to suffer any pain, and the digestion of the food is perfect. The fowl, even now as it is with its head cut off, tries to imitate a chicken with all its functions complete. It sticks its neck under its wing and tries to sleep like other chickens, and when food is offered to it, reaches out for it in a very natural manner."

All this is rather too much for any one to believe who possesses the least physiological knowledge. That a fowl will not die at once after the head is cut off, and will jump aimlessly around for several seconds, is well known; but any person possessing information upon the subject of the conditions of life, knows that by decapitation the carotid arteries are cut off, and that these, receiving a copious supply of blood directly from the heart, and intended for the brain, will pour out so much blood that the animal must soon bleed to death. Next to this cutting the spinal marrow, decapitation severs the nervous connection between the brain and the rest of the body, so that the functions of circulation, respiration and digestion are so seriously interferred with that they cannot possibly continue, except for a short time. In all warm-blooded animals the regulation of the various vital functions are so concentrated in the brain, that these functions not only become seriously disturbed, but very soon utterly impossible without a brain; they may linger longer in the lower orders of cold-blooded animals, such as frogs, in which the nervous power is less concentrated in a great ganglion, (which the brain is), but more diffused through the whole nervous system. But to suppose it possible that an animal with such an active circulation and respiration as a fowl, could live without a head, and even breath, respire and digest, is utterly absurd.

We are confident most people will perceive that the whole affair has been invented to create excitement and discussion among the ignorant; but we regret that editors employ such means to fill their pages for lack of something useful and really interesting.

Improved Power Shears.

The most important point in making power shears satisfactory in the long run, as now needed in large machine shops, is that the moving parts should be so situated as not to be subject to clogging up by dust and dirt, and at the same time easily accessible. These conditions have been very fully met in the power shears represented in Fig. 1, a product of the manufactory of the Pratt & Whitney Co., of Hartford, Conn.

As the engraving shows, the whole looks like a mere pedestal; but the working parts are contained inside, and accessible by doors. The whole is of immense strength and power, weighs more than two tons, and will cut round iron upward to 1¾ inches in diameter, and flat iron ¾ inch thick by 3 inches wide. In regard to the details, (which may be desired by those interested), we will state that a shaft passes through the machine from end to end, carrying a faced balance wheel, which serves as a pulley to drive it, by a connection by means of a Pratt patent friction clutch. The pulley revolves with a velocity of 280 to 300 revolutions per minute. On the shaft is placed a worm, which engages a large worm-wheel placed on a transverse shaft, and has an eccentric which is a part of the wheel, while a connecting rod engages the lower end or prolongation of a vertically moving cutter head, furnished with horizontal steel jaws on either side of the central bearing, which engage as shears with corresponding fixed jaws. One pair of these jaws is made with recesses of the form of segments of circles, to receive round bars, as seen at the left, while the other pair is straight, as seen at the right side. In front of these jaws are adjustable sliding rests, which resist the upward tendency of the pieces that are being cut, while at the back is an adjustable gauge, to determine their length.

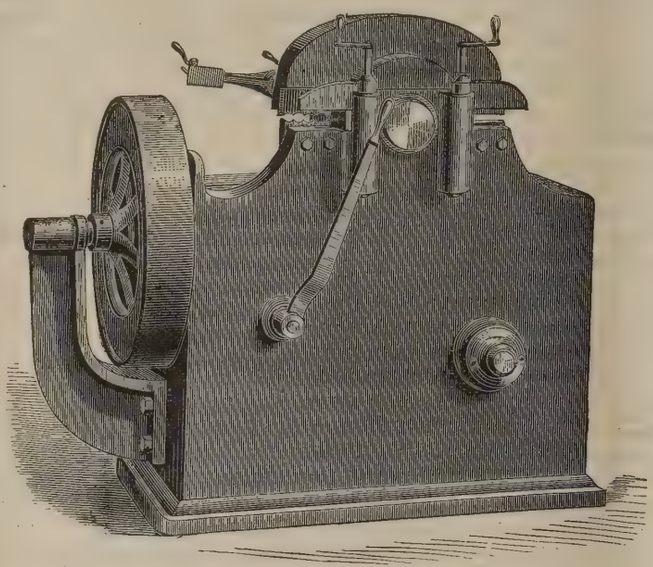


Fig. 1.—POWER SHEARS.

This machine is started and stopped instantaneously by the lever seen in front, and this without the slightest shock, while it works perfectly noiseless. The manner in which the starting and stopping is effected does not involve the least loss of power. The steel cutting blades may be removed for sharpening, and replaced with very little trouble, while the great power with which they are moved is a result of the peculiar combination of screw, worm-wheel, eccentric and levers.

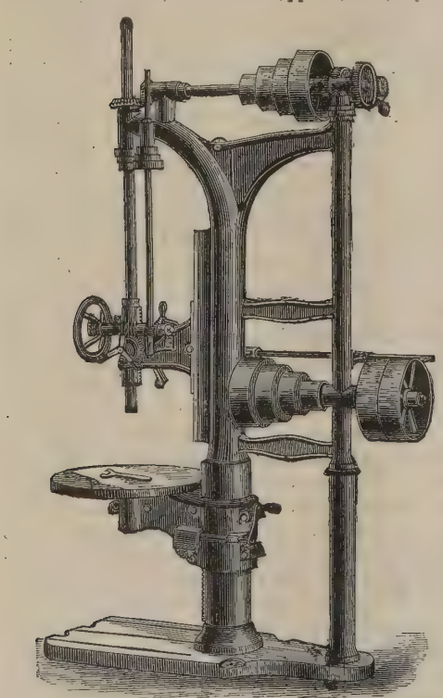


Fig. 2.—No. 2 Upright Drill.

Animal Rubber.

An insect which produces a species of India rubber has been recently discovered in the district of Yucatan, Central America, by an American explorer. It is called Neen, and belongs to the Coccus family, feeds on the mango tree, and swarms in that region. It is of considerable size, yellowish-brown in color, and emits a peculiar oily odor. The body of the insect contains a large proportion of grease, which is highly prized by the natives for applying to the skin, on account of its medicinal properties. When exposed to great heat, the lighter oils of the grease volatilize, leaving a tough wax behind, which resembles shellac, and may be used for making varnish or lacquer. When burnt, this wax produces a thick, semi-fluid mass, like a solution of India rubber, and it is expected that this glutinous liquid will be very valuable for cement and waterproofing.

The above extract need not alarm the producers of vegetable rubber. The quantity that could be produced by insects can only be as small and insignificant as the amount of carmine from the cochineal insect, and the result would be a costly product. If we were to obtain our rubber in such a way, there might scarcely be enough produced to supply vulcanite for dentists.

Improved Upright Power Drills.

In Figs. 2 and 3 are represented two upright power drills, as now manufactured by the Pratt & Whitney Co., of Hartford, Conn. It will be seen that they have a double column for support, which is an undoubted element of strength, solidity, and freedom from vibration, so fatal for all cutting machinery, and especially for drills. These columns are connected at the base, top and middle, which gives the maximum of stiffness required for heavy work, especially for the larger size, in which the adjustable heads are counterbalanced, as well as the spindles, while they have a quick return movement, automatic feed, and a Parkhurst patent index for gauging the hole to be drilled.

The No. 2 of these machines is represented in Fig. 2. It has a spindle 1⅝ inches in diameter, reaching from the column 13 inches; has tight and loose pulleys, 12 by 3 inches, and a table 24 inches in diameter, while the greatest hight of the spindle over the table is 4 feet 3 inches. It weighs 1,525 pounds. It is also made in two larger sizes, with tables of 30 and 42 inches diameter respectively, and other parts in proportion.

These drills are also made in three smaller sizes, of which Fig. 3 represents No. 3, called the Manufacturer's drill. They possess three arrangements for feeding the spindle. Each size is furnished with a hand lever, or with hand-wheel and worm-gear feed. The smallest size is also furnished with foot and hand lever when desired, while the spindle has a quick return movement with either arrangement. The spindle is always of steel, counterbalanced, and can be instantly adjusted to any point within its range, by loosening the friction of the wheel feed, or by withdrawing, by a partial turn of the handle of the lever, the bolt from the notched sleeve on the horizontal shaft of the drill-head, and turning the spider wheel which actuates a pinion engaging with a rack in back of the spindle.

The drilling table turns in the arm, which may be swung partly around the column when work is to be done on the base table, and may be adjusted vertically on the column by means of worm gear, pinion and rack in No. 3, and ratchet, pinion and rack in Nos. 1 and 2 machines, the rack being protected from chips and dirt by a guard. The base tables—No. 3 only having grooves—are planed, and attached to the columns at a right angle with the spindle. The countershaft is attached to the frame. The double column, connected to one base, gives the machine desirable stiffness and rigidity under heavy work that single column drills do not possess. The dimensions of the tables of the three smaller machines of the style represented in Fig. 3 are, 20, 17 and 14 inches; vertical adjustments of the tables, 25, 22 and 19 inches; distance from spindles to tables, 31, 28 and 25 inches; while the weights are 950, 800 and 625 pounds respectively.

Improvement in Ships.

A nautical invention has recently been brought out in France, which consists in forming the upper portion of the bulwarks of ships of loose sections, composed chiefly of hollow, thin metallic tubes, divided into compartments by diaphragms, the sections to be about 12 feet long; these are to be divided into a number of compartments of suitable form, and provided with projections on their under sides, so as to be fitted on to the place of the top rail of the bulwarks, serving as a substitute therefore. These sections, when immersed in the water, would form so many pontoons, and, being provided with cords and loops along their sides, would, in the event of the ship going down, be lifted out of their places by the action of the water. It is also proposed to construct the seats on the deck in the same manner, and underneath every seat, and along the entire length of the bulwarks, other floating tubes may be provided. In the case of sea-going vessels, the bulwark tubes are fitted with rings or slots, so that they may be joined together before or after taking to the water.

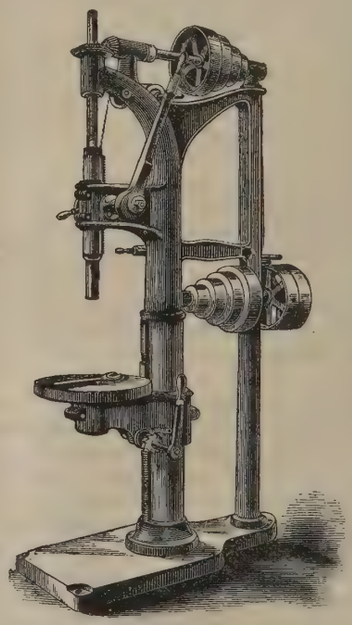


Fig. 3.—Manufacturers' Drill.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$55 00 *a* 60 00
Pine, good	45 00 *a* 50 00
Pine, shipping box	18 00 *a* 22 00
Pine, common box	15 00 *a* 17 00
Pine, common box, ⅝	14 00 *a* 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	35 *a* 40
Pine, tally plank, 1¼, 2d quality	35 *a* 38
Pine, tally plank, 1¼, culls	25 *a* 28
Pine, tally boards, dressed, good	28 *a* 30
Pine, tally boards, dressed, common	22 *a* 25
Pine, tally boards, culls, dressed	21 *a* 23
Pine, strip boards, merchantable	16 *a* 18
Pine, strip boards, clear	22 *a* 25
Pine, strip plank, clear	33 *a* 35
Pine, strip plank, dressed, clear	30 *a* 32
Spruce boards, dressed	20 *a* 22
Spruce plank, 1¼-inch, dressed	22 *a* — —
Spruce plank, 2-inch	35 *a* — —
Spruce wall strips	13 *a* — 15
Spruce timber, per M	17 00 *a* 20 00
Hemlock boards, per M	15 00 *a* 16 00
Hemlock joist, 2½x4, each	15 *a* — 16
Hemlock joist, 3x4	16 *a* — 18
Hemlock joist, 4x6	40 *a* — 44
Ash, good, per M	38 00 *a* 45 00
Oak	38 00 *a* 45 00
Maple culls	20 00 *a* 25 00
Maple good	42 00 *a* 45 00
Chestnut	35 00 *a* 48 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 *a* 40 00
Black walnut, good to choice	85 00 *a* 100 00
Black walnut, ⅝-inch	75 00 *a* 85 00
Black walnut, selected and seasoned	110 00 *a* 150 00
Black walnut counters, per ft	12½ *a* 25
Cherry, wide, per M	85 00 *a* 100 00
Cherry, ordinary	50 00 *a* 80 00
White wood, chair plank	60 00 *a* 70 00
White wood, inch	40 00 *a* 50 00
White wood, ⅝-inch	30 00 *a* 35 00
White wood, ⅝ panels	35 00 *a* 40 00
Shingles, extra sawed pine, 18-inch	4 00 *a* 5 00
Shingles, clear sawed pine, 16-inch	3 75 *a* 4 00
Shingles, cypress, 24x6	18 00 *a* 21 00
Shingles, cypress, 20x6	10 00 *a* 12 00
Lath, Cargo rate	2 25 *a* — —
Yellow dressed pine flooring	25 00 *a* 30 00
Yellow pine girders	30 00 *a* 40 00
Locust posts, 8 feet, per inch	18 *a* 20
Locust posts, 10 feet	24 *a* 25
Locust posts, 12 feet	29 *a* 34
Chestnut posts, per ft	3 *a* 3½
Basswood per M	25 00 *a* 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.		Afloat.
Pale, per M.	5 25	*a*	5 50
Up Rivers	7 75	*a*	8 00
Haverstraw Bay	8 00	*a*	8 25
" " choice	8 50	*a*	— —
Favorite Brands	8 75	*a*	9 00
Hollow Fire-Clay Brick	9 00	*a*	9 25

FRONTS.

Croton—Brown, per M.	8 00 *a* 8 50
" Dark	9 00 *a* 9 50
" Red	9 00 *a* 9 50
Philadelphia	21 00 *a* 23 00
Trenton	21 00 *a* 23 00
Baltimore	38 00 *a* — —
Clark's Ottawa White	25 00 *a* — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	31 00 *a* — —
" Glengarnock	29 50 *a* 30 00
" Eglinton	28 00 *a* 28 50
" American, No. 1	34 00 *a* 35 00
" American, No. 2	32 00 *a* 33 00
" American, forge	31 00 *a* 32 00

	Store prices.		Cash.
Bar, Swedes, ordinary sizes	— 6	*a* —	6¼
Bar, Swedes, nail-rod	— 6½	*a* —	—

LEAD—PER 100 POUNDS.

*German	— — *a* — —
*English, common	— — *a* — —
*Spanish	— — *a* — —
*Foreign, refined	— — *a* — —
*Bar, and Pipe	6 50 *a* 7 50
*Sheet	8 00 *a* — —
*Domestic	5 50 *a* 5 63½

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 70 *a* — —
8d and 9d, common	3 95 *a* — —
6d and 7d, common	4 20 *a* — —
4d and 5d, common	4 45 *a* — —
3d and 4d, light	5 20 *a* — —
3d, fine	5 95 *a* — —
2d, fine	5 95 *a* — —
Cut spikes, all sizes	4 95 *a* — —
Clinch nails, 1½ to 1¾ inch	5 95 *a* 6 20
do. 2 to 2¼ inch	5 70 *a* — —
do. 2½ to 2¾ inch	5 45 *a* — —
do. 3 inch and longer	5 20 *a* — —

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	8 00 *a* 8 50
*I. C. coke, 10x14	7 25 *a* 7 75
*I. X. charcoal, 10x14	10 50 *a* 10 75
*I. C. charcoal, 14x20	8 25 *a* 8 50
*I. X. charcoal, 14x20	10 50 *a* 10 75
*I. C. coke, 14x20	7 25 *a* 7 75
*I. C. coke, terne, 14x20	7 00 *a* 7 25
*I. C. charcoal, terne, 14x20	7 50 *a* 7 75

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 8¾ *a* — 8½
Sheet, (open)	— 9 *a* — 9½

SOLDERS.

No. 1	— 13 *a* — 14
No. 2	— 12 *a* — 12½

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 80 *a* — 85
Berlin Freestone, in rough	— 85 *a* — 95
Berea Freestone, in rough	— 70 *a* — 75
Brown-Stone, Portland, Conn	1 30 *a* 1 35
Brown Stone, Belleville, N. J	1 00 *a* 1 35
Granite, rough	— 60 *a* 1 25
Canaan Marble	1 25 *a* 1 50
Dorchester, N.B., Stone, rough, per foot	— — *a* 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 *a* 7 25
Chalk, per 100 lbs	— 85 *a* — —
China Clay, per ton gold	20 00 *a* 22 00
Chrome yellow, dry, per pound	— 12½ *a* — 28
Lead, red American, per pound	— 8 *a* — 9
Lead, white American, pure, in oil	— 9 *a* — 9½
Lead, white American, pure, dry	— 7¾ *a* — 8½
Lead, white English, pure, in oil gold	— 9½ *a* — 10½
Litharge	— 7½ *a* — 8
*Ochre, Fr., dry, per 100 lbs	1 50 *a* — —
Ochre, ground, in oil, per lb	— 6 *a* — 15
Ochre, Vermont, per 100 lbs	— 75 *a* 1 00
*Orange Mineral, English gold	— 9½ *a* — 10
Paris White, American	— 1½ *a* — 1¾
Paris White, English, prime	— 2 *a* — 2¼
Paris Green	— 15 *a* — 28
Plumbago paint, patent, per lb	— — *a* — 25
Putty, per lb	— 2½ *a* — 3
Spanish Brown, dry, per lb	— 1⅛ *a* — 1¼
Spanish Brown, ground in oil, per lb	— 8 *a* — 9
Venetian red, per cwt	1 75 *a* 2 00
*Vermilion, Chinese, per lb	— 85 *a* — 90
*Vermilion, Trieste	— 70 *a* — 75
*Vermilion, quicksilver, bags gold	— 60 *a* — 62½
Vermilion, American, common	— 15 *a* — 18
Whiting, per 100 lbs	— 60 *a* — 80
Zinc, white American, dry, No. 1	— 5 *a* — 7½
Zinc, white American, No. 1, in oil	— 8 *a* — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¾ *a* — 9
Zinc, white French, in oil gold	— 10 *a* — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 *a* 4 00
Coach Body	2 35 *a* 3 50
do do	1 80 *a* 2 00
Furniture	1 25 *a* 2 50
Black Asphaltum	1 00 *a* 1 50
Brown Japan	1 00 *a* 1 20
Liquid Paint Dryer	1 35 *a* 1 75
Harness, (black)	3 00 *a* 4 50
Shellac, Spirits	3 00 *a* 3 50

CEMENT—PER BARREL.

Portland (imported)	2 90 *a* 3 25
Portland (American)	2 50 *a* 2 75
Portland (Spanish)	2 50 *a* 2 75
Portland (Lafarge)	3 20 *a* 3 40
Portland (German, Bonner)	2 75 *a* 3 25
Lime of Teil	2 20 *a* 2 30
Lime of Teil, per ton	15 00 *a* 18 00
Roman	2 75 *a* 3 25
Keene's, coarse	6 00 *a* 6 50
" fine	10 50 *a* — —
Martin's, coarse	6 00 *a* — —
" fine	10 50 *a* — —
Rosendale	1 00 *a* — —

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb. — 1¼ *a* — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 9 *a* — 12½
Goat, " "	— 15 *a* — —

SLATE.

Purple roofing slate, per square	$6 00 *a* 6 50
Green slate	7 00 *a* 7 50
Red slate	10 50 *a* 11 00
Black slate, Pennsylvania, (at Jersey City)	5 00 *a* 5 25
" Cargo rate	3 50 *a* 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 *a* — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 25 *a* 3 50
Nova Scotia, blue	3 00 *a* 3 25
Calcined, Eastern and city, per bbl	1 00 *a* 1 15
Calcined, city casting	1 20 *a* 1 25
Calcined, city superfine	1 30 *a* 1 50

LIME—PER BARREL.

State, common	— 75 *a* — —
" finishing	— 90 *a* — —
Rockland, common, cargo rate	— 85 *a* — —
" finishing	1 00 *a* — —
Ground	— 85 *a* — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 20 *a* — 35
St. Domingo, crotches, fine	— 25 *a* — 50
St. Domingo, logs, small	— 5 *a* — 8
St. Domingo, logs, large	— 20 *a* — 30
Frontera, Mexican, large	— 11½ *a* — 16
Frontera, Mexican, small	— 8 *a* — 10
Other Mexican	— 8 *a* — 14
Honduras	— 10 *a* — 15

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ *a* — 6
Rio Janeiro, good to fine	— 5 *a* — 8
Bahia, ordinary to good	— 2 *a* — 6½
Bahia, good to fine	— 4½ *a* — 8
Honduras, per ton	10 00 *a* 20 00
Satin Wood, per foot	— 15 *a* — 60
Tulipwood, per lb	— 6 *a* — 12½
Lignumvitæ, small, per ton	10 00 *a* 20 00
Lignumvitæ, large	25 00 *a* 50 00

CEDAR.

Cuba, per superficial foot	— 10 *a* — 12½
Mexican, small	— 8 *a* — 10
Mexican, large	— 10 *a* — 14
Florida	— 30 *a* 1 50

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13		10 inches diameter,		$0 70
3 "	0 16		12 "		0 80
4 "	0 20		15 "		1 25
5 "	0 25		18 "		1 60
6 "	0 30		20 "		2 00
7 "	0 35		22 "		2 50
8 "	0 45		24 "		3 00
9 "	0 55				

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¼ inch.	$ 84	—
2.6 x 6.6	1¼	1 18	—
2.6 x 6.8	1¼	1 24	—
2.8 x 6.8	1¼	1 30	—

OUTSIDE BLINDS.

Up to 2.10 wide, per lineal foot		25 *a*	—
Up to 3.1 wide		27 *a*	—
Up to 3.4 wide		30 *a*	—

GENERAL REVIEW OF THE MARKETS.—Business during the past month has presented but few features of interest additional to those contained in our December report, in which a steady improvement in the markets was noted. Prices have been well sustained, and the supplies on hand have in most cases been ample to meet all demands. Building operations continue very active throughout the upper portions of the city, and the present indications are that the coming spring will witness one of the busiest seasons that has been seen for years. In every branch of the markets the outlook is most promising; it will require some extraordinary circumstance, not now forseen, to change their present prosperous and healthful condition.

THE MARKETS IN DETAIL.—In the lumber market the past month the tone has been quite firm, although the distribution to consumers has been comparatively light. Supplies have been a little larger than expected from some quarters, but not enough to cause any uncomfortable accumulation, and indeed there are many dealers who would gladly welcome an increased offering and assortment as a means of filling up the stocks they should have attended to earlier in the season.

In the brick market there has not been much change in the general condition during the past month. Values have shown much strength, and sellers have experienced no difficulty in securing full former rates.

In the lime market prices have advanced on Rockland, and we quote common at 85 cents as against 65 cents last month, and finishing at $1 as against 85 cents. Demand has been good for both Rockland and State during the month, and would even exhaust more than the present offering covers, but sellers do not seem to consider it advisable to make any important additions to supplies at present.

In the lath market stock coming to hand since our last has all found a place, but the demand has not been quite so brisk or general as could be desired.

In the hardware market business has been quite dull in wholesale operations; this, however, is seasonable, and therefore has excited no comment. The bulk of the trade done has been confined to the city, very few orders being received by mail.

In the metal markets American pig iron has again commenced to show something of a tendency to "boom," the demand proving quite free for early and future delivery, with values buoyant. Manufactured iron has, for this season of the year, shown considerable animation, stimulated by the increasing cost of material. Domestic pig lead has been unusually active, and the tone of the market has ruled steady. Pig tin has met with rather a light demand, the supply present and prospective being somewhat fuller than anticipated, and the market has had rather a weak tone. Tin plates have found a very good general demand, and the position of values has been well strengthened all around.

In the paint market the movement of supplies has been of a jobbing character in the main, and there is not much of a market for the time being.

Iron Now and in 1872.

Large as has been the advance in iron and manufactures of iron, to-day's prices are still very far from approaching those of 1872. The best foundry pig iron is quoted at $34.50 per ton to-day, against $17.62 in 1878, and $48.87½ in 1872. New iron rails are quoted at $54 *a* $58 to-day, against $33.50 in 1878, and $85 in 1872. Steel rails are now valued at $70*a*$72.50, against $42.26 in 1878, and $112 in 1872. Ordinary refined iron is now quoted at $78.40 per ton of 2,240 pounds, against $43 *a* $44 in 1878, and $95 *a* $100 in the latter part of 1872.

Benefits of Co-operation.

Mr. George Jacob Holyoake, the great English co-operator, spoke recently at the Cooper Institute in this city on the subject of co-operation. He began by telling of the interest he had taken in co-operation all his life. He had, he said, been an active worker in schemes for co-operation in England for years. His first point was as to the benefit of co-operative action to the English immigrants coming to this country. By co-operation, he said, their passage across the ocean could be made a pleasure excursion. Then, too, they could be conducted to places already prepared for them, and thus, by co-operation, they would not be reduced in circumstances so much that they would be left as a burden upon the great cities. In speaking of the Socialist-Labor Party Mr. Holyoake predicted that it would become much larger than it now is in the United States. The laborer would lack common sense, he thought, if he stood idly by while machinery showers gold upon capitalists. In England the times had been such that some people could live without labor, while others could not live with labor. Such a condition of affairs should and can be improved by co-operation. The cry of the Labor Party in England was that the government should assist them; but the co-operative workers only asked the government to let them alone and they would get along all right. The speaker then turned his attention to the movement in England, and gave a history of what the supporters of co-operation had accomplished there. The co-operative stores were described as having languished for 25 years, and then sprung into success when it was found out that the best plan was to pay 5 per cent to those who put in capital, and divide the profits among the consumers. An illustration of the extent of the business was the fact that two vessels are now engaged in carrying to England the American produce purchased for the co-operative establishments. Mr. Holyoake surprised the audience in a glowing description of the beauties of the system by declaring that one of its peculiarities was that the larger a member's family was, and the more they ate, the richer he became. By the co-operative bank system members grew rich while they slept, even if they had put in no money. They paid no money, but yet they grew rich. Referring to the subject of co-operative colonization the speaker thought there ought to be no trouble in establishing co-operative communities. Imagining such a colony of 100 persons on a thousand acres of land, Mr. Holyoake showed how they could make what they needed to wear, and produce what they needed to eat. When they produced more than the colony needed, the surplus could be exchanged with persons outside of the colony. If that could not be done, then the colonist would eat their surplus food themselves, and themselves wear and use their surplus articles of manufacture. Good feeling between employers and employees was advocated at some length by the speaker, who then showed how co-operation would bring about such a feeling. He urged that true information should be given the foreign workingmen regarding the prospects immigrants might expect here, and closed by claiming that co-operation was no Utopian scheme. The Rev. R. Heber Newton, one of the officers of the Co-operative Colony Aid Association, among some remarks made after Mr. Holyoake had finished, explained that the chief peculiarity of co-operation in England was co-operative distribution through co-operative stores; in France it was co-operative production, through manufactories; in Germany it was co-operative credit through the co-operative banking system. In this country the first thing the supporters of co-operation wanted to do was to enable the distressed laborers in great cities to go in goodly companies to places in the country, where they could live happily in co-operative villages and work together for each other's good. After detailing the hopes and plans of the Co-operative Colony Aid Association, Mr. Newton gave way to Rev. Dr. J. H. Rylance, one of the Executive Committee of the association, who spoke in eulogy of Mr. Holyoake, and predicted that the time was coming when American workingmen would consider social questions of far more importance than the discussion of political tropics.

Patent Fastener for Machinery.

An English exchange says: "The importance of properly securing all machinery to the estate of the individual or firm to whom it ostensibly belongs, has been demonstrated in many instances. Numerous cases have occurred within the last few years where valuable machinery has, under the existing law in England, passed out of the hands of its proper owners into the absolute possession of the landlord of the freehold, or, in the case of the failure of a manufacturer or of a firm of manufacturers, a considerable portion of the plant has become lost to the debtor's estate by reason of its being attached to the freehold in the usual manner. A simple and effective means is now, however, available by which looms and other machinery may be securely fixed down to the floors of rooms in mills or elsewhere, while rendering the machinery separable from the freehold, and consequently not liable to be claimed by either landlord or mortgagee as fixtures. The contrivance to which we refer is a patent shoe; it consists of a single iron casting and of a loose plate or cover, which can be attached to the broad part of the shoe by means of two screws at each end. In order to use it the shoe is placed with its flat side upon the floor, so that the two arms lie on each side of the foot of the loom or other machine which is to be fixed, and is firmly fastened down to the floor by a screw. The covering plate is then placed over the foot of the machine and screwed down tight to the shoe at each end; a pin is passed through a hole in the middle of the cover, and drops into a corresponding hole in the foot of the machine, in order further to secure it. Thus the only part which is fixed to the floor of the building, and consequently irremovable, is the shoe itself.

Fortunately for us, we do not need such devices, as our laws are quite different, giving the tenant the right to take with him when he moves out anything he brought in, whether or not he had it fastened to the walls or floors. In Europe and other countries, the universal law is, that when a tenant nails or screws anything to the floors or walls, it virtually becomes the property of the landlord, as the tenant has no longer a right to loosen and carry it away when he moves out. The English contrivance above described is a tricky device, invented to evade an unjust law, by fastening only a shoe to the floor. This alone becomes the property of the landlord, as the law declares it irremovable; but the law not having provided for other objects attached to this irremovable shoe, anything can be screwed or bolted to this without also becoming the property of the landlord.

Let us bless the laws and customs of our country, as they have not been contrived for the special benefit of landlords as is the case in England, and of which the present agitation in Ireland is only a natural result.

Cork and its Value.

The constantly increasing demand for cork for bottling and other purposes, together with the fact that the cultivation of the tree is sadly neglected, threatens to cause a serious dearth of the article. Yet no other substance has been discovered that will serve as a substitute for cork in many of the uses to which it is applied. Cork is worth eleven times what it was a century ago, and its market value is continually increasing. The American Commissioner of Agriculture has satisfied himself that the cork tree can be successfully cultivated in various parts of the United States, and in his report for 1878, just issued, recommends that the government offer premiums to those who, within a reasonable specified time, shall have obtained the best results in cork culture. In Sicily, Sardinia, and the kingdom of Italy, great plantations of cork trees have been destroyed to obtain the tannin from the bark. After having been stripped of their bark, the trees were burned, in order that the carbonate of soda might be extracted from their ashes. In 1822 the French government began to nurture this important interest, and France now has about 500,000 acres of cork plantations in Algeria. The tree grows as high as 65 feet, with a diameter of from 3 to 5 feet, and will live and yield cork from 150 to 200 years. In a dry, sandy, siliceous soil, at an altitude of from 1,600 to 3,200 feet, and not further North than the 45° of latitude, cork plantations will flourish. The tree does not, however, yield valuable cork until it is towards 15 years old.

Organ for the Cathedral at Garden City.

The new organ now being built by Mr. Hilborne L. Roosevelt, for the cathedral at Garden City, Long Island, will rank among the largest, and in several respects will be one of the most remarkable in the world. It will be placed in four different parts of the cathedral. The main body of the instrument will stand in the chancel, and the organist will sit there. At the west end of the building, in a tower directly behind a large stained glass window, is a room in which a part of the organ will be placed and connected with the chancel by electricity, like the organ built by Mr. Roosevelt in Grace Church, this city. The window will be opened and closed by electricity, controlled by the organist from the chancel, thereby making fine crescendo and diminuendo effects with the organ in the tower. Over the ceiling, about the center of the building, will be placed another part of the instrument called the "echo organ," which is to be played from the chancel by electricity. Underneath the chancel, in the chapel situated there, is a part of the organ which is arranged so that it can be played in the chapel as well as from the chancel. Lastly, the large chimes which hang in the tower will be connected with the chancel by electricity, so that the organist can play them from the keys of the organ. The bellows will be operated by hydraulic engines, and the organist can, by simply turning on the water, have the whole instrument, including the chimes, at his command. Though this will be a mammoth instrument, and notwithstanding the great distance between many of its parts, the pressure necessary to play on the keys will be no greater than is used in playing upon a piano. This is due to the use of electricity, pneumatics and hydraulics, which combined, render it possible and practicable to construct such an instrument.

There will be four vox humanas, (similar in construction to the celebrated one in Freiburg); one of these will be in the chancel, one in the tower, another over the ceiling, and a fourth one in the chapel beneath the chancel. All of these will be under the control of the organist in the chancel, and will be capable of crescendo and diminuendo effects. In all there will be one hundred or one hundred and twenty speaking stops, the exact number not yet having been determined upon. The Boston Music Hall organ has eighty-four stops, the Cincinnati ninety-six, and the largest organ in the world—that in Albert Hall, London—one hundred and eleven. Five hydraulic engines will be needed. Quite a small Gramme magneto machine will furnish all the electricity needed. Where mechanical force is required, as in ringing bells or opening windows, compressed air will be used in an ingenious manner, devised by Mr. Roosevelt.

The cost of the instrument will be from $35,000 to $40,000. It will be put in place next spring.

THE ELECTRIC HOSE.—A new thing in fire apparatus is the electric hose. A wire runs along in the cotton or rubber part of the hose, continuing the connection as each section is attached, and over this passes electricity, generated by one of the fly wheels of the engine. Connected with the nozzle is a little contrivance by which the engineer can be directed, although squares distant from the man who is playing water on a fire, to turn her on, cut her off, stop, go ahead, or any thing else that may be agreed upon by a signal which is struck on a gong attached to the engine.

Home Department.

Overwork.

A lecture on "Labor and Longevity," recently delivered in St. George's Hall, London, by Mr. Brudenell Carter, contains a number of points of the highest interest not heretofore brought out, in connection with the much discussed question of overwork. The lecturer is in full accord with the views of those who insist that brain-work is strongly conducive to longevity. He further insists that the popular notion of overwork is a mistaken one. Ordinary brain-work, even when the man is taxed to the full extent of his powers, does not shorten life. Nature interposes her guardian hand when the effort is made to overstep the limits, and rest and sleep recuperate the spent forces. Overwork comes in when, in addition to the mental activity, the passions are aroused.

After a while, as we become accustomed to attend steadily to a particular class of ideas, we attend to them easily, compare them without effort, and carry out the conduct they may suggest in a manner nearly if not quite involuntary. Whatever a man's business in life may be, he learns it, as the child learns to walk, by an act of conscious attention to each step of the process, till, after sufficient practice, the attention becomes automatic or instinctive. The details of every calling are obscure and confusing to people not versed in them, and superficial observers wonder at the ease with which these details are kept in hand, and applied as the result of habit. Brain-work of this sort, effort of a kind that has become habitual, forms the chief part of the real working life of every man whose labor is with his mind rather than with his hands, and differs widely from that brain-work whereby a calling is first acquired. In the latter only a short continuance of application is possible to ordinary persons, but in the former the limit of application is only fixed by the ordinary work of sleep.

On the other hand, the combination of an idea with pleasure or pain produces an emotion, and every emotion liberates force, and has a tendency to go out in action. The human subject is able to check this force, or even to restrain it from evident action altogether, and such restraint is painful and hurtful, and its removal a relief to the system. The repression of the depressing emotions is far more hurtful than that of the pleasurable. Grief, disappointment and envy, when restrained from external display, exert an injurious influence on the nervous system of organic life, while it governs the processes of secretion and repair. In cases where any one of these passions has been very strongly aroused, and yet finds little or no outlet in action, the victim may droop and die, and is then said to be broken-hearted; in cases less severe, extreme impairment of health may be produced, the mischief done appearing to be a diminution or deprivation of the nervous power applied to the maintenance of organic life. The operation of acute depressing emotions, when thrown back upon the system, may help us to understand the operation of depressing emotions of a more slight but abiding character, such as the various feelings called collectively anxiety. Very many people, after deciding on a course of action, still go on musing, or rather puzzling, as to whether they should not have decided differently. Under this description may be brought most of the so-called brain-work from which men suffer. The proper steps having been taken to give effect to his decision, he can no further influence the result. If he be wise he dismisses the matter from his thoughts, but if he be not wise it will be constantly before him, the object of automatic attention. He would say he was thinking about it. In reality he is not thinking at all in any proper sense of the word. He is merely keeping alive emotions, either pleasurable or painful, which, in the latter case especially, cannot fail to be hurtful, and the same kind of trouble recurring again and again, the sufferer is at last said to have died of overwork. Other things being equal, the man whose brain is kept active and recipient, where the highest mental faculties are constantly exercised, and whose attention to his emotions is subject to the dominion of his will, that man's life will be the longest, as certainly as it will be the happiest and best.

Ornamented Veneer.

We have on former occasions acquainted our readers with the ornamentation of veneer used for seats and backs of chairs, by making the perforations according to certain tasteful patterns or designs, and have also illustrated various styles of the same, as manufactured by Gardner & Co., of 183 Canal street, New York, who are continually extending their business to meet increased sales, as well as adding to their productions.

One of the latest of their many products is represented in the adjoined engraving. Not satisfied with the kind of ornamentation which the perforations produce when made according to symmetrical figures, and by which the style of ornamentation is of course limited to certain geometrical forms, they have introduced

The Base Rocker.

designs of flowers and other ornamental objects on the backs of the chairs, which, when surrounded by rows of perforations, look as if they were set in frames.

This new feature has been applied to the Base Rocker, which, as the engraving shows, is not only of elegant design, but also well made, and if it costs a little more than the cheap rockers now in the market, is more than worth the difference, and on account of its strength, will prove the cheapest in the end. In fact, cheap chairs are dear after all, as they do not last, while a more expensive but well built chair, will outlast the lifetime of any man. A chair which cannot do that, but breaks down at some unexpected moment, is a very disagreeable thing to have around.

Cause of Drunkenness.

Dr. Jackson expresses the opinion that one of the most common inducements to the use of alcohol, is that people overwork themselves, and being so exhausted that they cannot sleep, resort to smoking, chewing, and alcohol drinking. This may sometimes be the case, but we can testify to having learned by observation that men do not become drinkers because they cannot rest, but because instead of devoting their leisure hours to useful reading and proper entertainments, they spend them in drinking saloons among dissipated companions, or they drink at home to kill time. When a man is fatigued from bodily labor, all he has to do is to keep his mind occupied with reading, or have others read to him, and he will soon feel sleepy. The kind of reading has, of course, much influence, and a man must learn by experience what kind of literature will keep him awake, and the sort that will cause him to sleep.

Good Points of the Cockroach.

A writer in *Good Words* expresses it as his opinion that the cockroach is a most useful insect as a scavenger and thinks it an error to endeavor to eradicate it from our houses, he says: "I am often asked whether the cockroach can have any redeeming points with regard to its relationship to civilized man, or whether it be not an unmitigated pest, which ought to be exterminated wherever it is found. That is a nuisance is undeniable, but that it ought to be exterminated is very doubtful. In the first place, it is, like the sewer rat, an invaluable scavenger, eating substances which might decay and breed fevers if allowed to remain. It is never seen in dry and perfectly clean places where it can find no food, and its very presence is a sign that it is needed. Perhaps people may say that they can put up with cockroaches in kitchens and outhouses, but when they come into bed rooms it is time that they should be abolished. I very much doubt whether they should be destroyed even under such circumstances. Cockroaches are not likely to take the trouble of going up stairs into bedrooms unless they have some object in it, and that object is generally the flatter and smaller insect which prefers bed rooms to kitchens. Sailors are well aware of this fact, and that 'Norfolk Howards' and cockroaches cannot exist in the same ship, and a curious instance of this fact is recorded in the 'Narrative of Foster's Voyage in the Chanticleer;' 'Cockroaches, those nuisances to ships, are plentiful at St. Helena, and yet, bad as they are, they are more endurable than bugs. Previous to our arrival here in the Chanticleer, we had suffered great inconvenience from the latter, but the cockroaches no sooner made their appearance than the bugs entirely disappeared. The fact is, the cockroach preys on them, and leaves no sign or vestage of where they have been; so far it is a most valuable insect."

A Remedy Making Spectacles Unnecessary.

Dr. W. Cheatham writes to the Louisville *Medical News* that he has found that the use of the sulphate of eserin makes it unnecessary to use spectacles in case their use is called for by a flattening of the cornea from old age—a very common ailment, called presbyopia. He states that this drug possesses the property of acting especially on the ciliary muscle, and contracting it, which contraction increases the convexity of the cornea. He recommends dissolving 1 gram of the sulphate of eserin in 1 ounce of water, and putting one drop in each eye at bed-time. It produces at first the opposite defect—a too great convexity of the cornea, which is called myopy, or near-sightedness, which however soon passes away.

He thinks the use of this remedy perfectly safe, and also adapted in cases of glaucoma and other inflammations of the eye, in cases of weakness resulting from overwork, general debility, diphtheria, etc. He says that notwithstanding the use of spectacles in case of presbyopia gives comfort to the eyesight, there is also however always some trouble connected with them, which patients are often anxious to dispense with, and thinks they should be humored in this respect. We are of this opinion also, but advise caution in using this new remedy, because, as the effects are only temporary, a continuous use is of course intended, and experience has not yet shown what secondary effects may result from often repeated applications.

Onions as a Medicine.—A correspondent of an English agricultural journal says that onions are a poison for worms, and that a dish of boiled onions given to a child suffering from worms will kill them. Another correspondent maintains that they are the best remedy for rheumatism, either cooked or raw, while a certain medical man says that boiled onions are good for a cold

in the chest. We are glad to hear all this, and hope it may be true and verified by further experiments, so that onions will at least be good as a medicine if not for food.

GREAT MEN NOT ALWAYS RIGHT.—It is an argument often used that because a man of great ability supports an opinion, belief or cause, the same must possess the merit of right and truth. Macaulay well said: "As if history were not made up of the bad actions of extraordinary men; as if all the most noted destroyers and deceivers of our species, all the founders of arbitrary governments and false religions had not been extraordinary men; as if nine-tenths of the calamities which have befallen the human race had any other origin than the union of high intelligence and low desires."

Miscellaneous and Advertising.

All kinds of new and second-hand machinery can be obtained at the George Place Machinery Agency, 121 Chambers and 103 Reade streets, New York.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

The average annual value of musical instruments made in Paris during the last six years has been $4,600,000, divided among 360 makers, employing no fewer than 5,000 workmen.

The attention of plumbers, builders, house-owners and house-holders is called to the large line of plumbers' goods manufactured by Henry Steeger at 143 and 145 East 31st street, New York, including bath tubs, copper boilers, closet pans, pantry sinks, foot and seat tubs, etc.

Clark & Co., of 162 and 164 West 27th street, New York, report business very active, and state that it has been constantly on the increase during the past season. Their shutters have met with great favor wherever they have been employed, and are rapidly displacing the old style shutters, which at best are inconvenient and troublesome.

One of the most enterprising firms in the South is the long-established house of Poole & Hunt, of Baltimore, Md., who have made themselves a great name in the manufacture of their various productions, by always sustaining for them a standard of uniform excellence. This has been true of their machine molded gearing, shafting, pulleys and hangers, of which they make a specialty, as well as of their other manufactures, including their celebrated Leffel turbine, which is meeting with a large and increasing demand.

The Tanite Co., of Stroudsburg, Pa., so widely and favorably known all over the world, are very busy at their works filling orders for their goods, comprising all styles of emery wheels and grinders. The high quality of all the work turned out by this company is the result of employing only the very best material and workmanship in the manufacture of their productions. Those wishing wheels or grinders cannot do better than write the Tanite Company for their illustrated catalogue, which will give some idea of the multifarious styles of goods that are produced by these enterprising manufacturers.

Charles Kellogg, of North Amherst, has invented a machine for fastening buttons on cards, a process heretofore done by hand with a needle and thread, a day's work being about 40 gross for a smart workman. The machine is calculated to fasten one gross per minute on cards containing two dozen each, or 60 gross per hour. It is about two feet long and 15 inches wide and as many high, and fastens the buttons to cards with fine wire. Four buttons are fastened or wired at a time, the card moves along and four more are wired, and so on until the required number is on the card, when another card is pushed along from the top of a pile of two hundred or more on the machine. One girl can attend to each machine.

The Homestead.

BY F. T. CAMP, ARCHITECT.

This is the third and last of the series begun in the November issue, entitled "The Growth of the Cottage," and is named as above. The interest awakened by the first parts seems to continue with unabated ardor, and there is no doubt that the illustration given this month will give a solution to many who have desired just such a plan, but did not know how to carry it out.

For the benefit of those who may see this design, and not understand that it is part of a series, and who have missed seeing what has been before published in relation to it, a brief summary will be welcome.

The design then of this series of three illustrations, the first of which appeared in the November number, is to so plan a cottage that it might be subsequently enlarged twice, making the additions with an eye to a completed whole, so that nothing is built which need be demolished at the subsequent enlargement, and also so treating the additions that they do not appear to be the after-thoughts and patches that such operations usually present; but the house, after each enlargement, has a finished look, and could be left complete at its first or second stage—looking, and really being as well, for its situation, size and price, as any plan not designed for completion by stages.

The additional accommodations given in the second, over those provided in the first plan, are, increased cellar room, a front stairs, hall, vestibule, parlor and side porch; a large chamber over parlor, with bath-room adjoining, placed between the two principal chambers, and accessible from them, and also the hall. This is a *beau ideal* situation for a bath-room, with the one exception of being rather far away from the kitchen, where the hot water to supply the bath must be generated. The consideration, however, of the private accessibility from the two chambers—the best rooms on the floor—and also equal ease of approach from the hall, point out this situation as the best, notwithstanding its remoteness from the kitchen. The front stairs can be continued to the attic, where three well lighted rooms can be formed, and two sufficiently lighted store-rooms.

The addition shown this month, on the *Family House* to make it a *Homestead*, are two rooms on each of the three stories, and a cellar under the whole. Perhaps the cellar room already provided would be sufficient, without increasing it. The attic rooms in the new part have been particularly studied, and the whole planned so that the picturesqueness of the exterior is justified by the excellent wall space secured for the attic rooms.

The cost of this addition to the Family House would probably be in the neighborhood of $3,000, if a cellar is made under it, and a few hundred dollars less if no cellar is finished under that part.

We can furnish the plans for this house complete, with details and specification for $50, and any questions or correspondence in relation to it will be promptly answered by the architect, F. T. Camp, No. 206 W. 33d Street, New York city.

SPECIFICATION.

Excavate under whole house. Grade dirt around finished walls, or take off the premises, as may be directed. Lay base course 1 foot below cellar bottom, 6 inches on each side wider than net foundation wall, of large flat stone, laid across the trench. Net wall in center of base course, built to figured dimensions, of large rubble walling, laid to a line on both faces, in common brown mortar of the usual richness, pointed above grade with black mortar, made with Rosendale cement. Window sills of cut stone; also coping of chimneys, neatly chisel-cut. Foundation wall to extend under porch, making part preparation for subsequent additions contemplated in this series. Piers in cellar, also chimneys, of ordinary kiln hard-burned brick, laid in brown mortar, according to plans. Between joists over partitions to be filled with brick, to stop drafts and vermin.

Plaster.—Lath all side walls and ceilings in first and second stories with good sound lath, well nailed, and cover with one coat brown mortar well haired, one coat browning well floated and trued, and finish with coat of lime putty and calcined plaster, properly gauged, floated, trowelled, and polished. Run stucco cornices in the following rooms, and of these sizes: Parlor, 7½x13 inches; center, 2 feet 9 inches diameter. Dining-room cornice, 6x10 inches; center, 2 feet diameter. Hall cornice, 5x8 inches; center, 18 inches diameter. Vestibule cornice, 3x6 inches. All other cornices, 4x7½ inches.

Carpenter-Work.—Sizes of timber as follows: Sills, doubled, 2x6 inches; studding, 2x4 inches; partition caps, doubled, 2x4 inches; braces, 2x4 inches; joists, 2x10 inches; bridging, 2x2 inches; rafters, 2x8 inches; ceiling beams, 2x6 inches—all of sound, square-edged spruce or hemlock, worked and erected in style known as "balloon" frame, thoroughly spiked and nailed. Roofs covered with gang-sawed hemlock boards, well nailed, also outside of vertical walls. Cover walls with building paper, and roofs with tarred paper. Clapboard walls with 5-inch bevel sawed pine clapboards, laid 4 inches to the weather, and slate roofs with unfading black or purple slate 10x20 inches.

Outside finish of a good quality of white pine, well seasoned. Corner boards and window and door frames of 1¼-inch; friezes, panel backs, beaded ceiling in panels, piazza posts, cresting, ornamental cut facia of cornice, etc., of ⅞-inch. Brackets built up. Water-table of 1½ inches. Cap got out of solid. Porch floor of yellow pine, over a rough hemlock floor, with tarred paper between, the yellow pine joints thickly white leaded. Porch roof covered with tin. Sash of 1½-inch white pine, well seasoned, ogee, check rail, number of lights shown on elevations, glazed with second-quality American sheet glass, bedded in soft fresh putty, hung with pulleys, weights and best hemp cord, and fastened with an approved sash lock.

Outside doors of pine, 2¼ inches thick. Front doors as shown, with plate glass top panels, lower panels raised molded, center panel with raised center, alike on both sides. Vestibule door a wide single door, with three panels—top, middle and lower—the top and middle panels of embossed glass, and the lower panel raised, and all enclosed in raised moldings, both sides alike. Kitchen door, four-panelled, ogee inside, and raised molded outside. These doors hung with three butts each, trimmed with good locks and catches, also bolts of brass, flush on front door. Interior doors hung with two butts to a door, trimmed with mortise locks and catches, to be 1½ inches thick, and all doors to have white porcelain knobs, with silver-plated roses and escutcheons.

Floorings of 1¼-inch spruce plank, not over 6 inches wide, matched, tongued and grooved, and blind nailed. Stairs, front flight to extend to attic, open, and built with wall string, molded same as base in hall up to passage to rear part; then molded as for the rest of second story up to attic. A good newel, costing about $8; rail, 2½x4½ inches, toad-back, 2 inches square, and turned balusters, dovetailed to ends of steps; all of black walnut; to trim front flight. Risers, ⅞ inch and treads 1½ inches, molded, nosings housed in wall strings; all of clear white pine. Stairs open under on first floor. Rear stairs one close flight, steps housed in strings; risers, ⅞ inch; treads, 1½ inches; molded nosings; all of white pine; newel, 8 inches, of black walnut, square base, and turned shaft; rail plain toad-back, 2½x4 inches; balusters, 1½ inches square, turned shaft. Flight to cellar of rough stock; treads, 2 inches; risers, 1 inch; white pine, and common hand rail below floor.

Inside Finish.—Architraves in hall, parlor, dining-room, library, chamber and front rooms of second story, of pine, 5 inches wide, with a band mold 1x2 inches. In other rooms 5-inch plain bevelled. Bases in first-mentioned rooms 10 and 8 inches high; in first and second stories 9 inches high, including 2-inch molding. Plain bevelled bases in rest of rooms, closets, etc., all of a good quality clear white pine. Windows in principal rooms panelled under, and architraves brought to the floor.

Fittings.—Cupboards in stair passage to have glass doors above and drawers below, in the usual form; shelves behind glass doors. Other shelving in pantry and over sink in kitchen—open. Closets in second story to have three shelves where marked. All shelving on beaded cleats (screwed), of good pine. Tubs in laundry of 2-inch clear pine plank, dadoed, and joints painted with thick white lead. Sink shelf of 1½-inch pine. Sink of iron, and open underneath. Provide and set on stand a 40-gallon, heavy sheet-iron, riveted, galvanized boiler, stand in kitchen near chimney and ready to connect with water-back of portable range through ¾-inch triple A lead pipe, supplied from street or tank through 1-inch galvanized wrought-iron pipe. All supplies to water-closet, bath and wash tubs, and sink, to be ¾-inch galvanized wrought-iron pipe. Cocks of ⅝ lever, brass for sink and wash-trays and silver-plated for bath-room. Water-closet pull and cup silver-plated, and the closet to be of the Jennings style. Tub and seat cased in panelled black walnut; seat to have two brass hinged lids, and tub a surbase of wainscoting 12 inches high. Pipes run in warm, sheltered situations. Clothes hooks on cleats in all closets. Five marbleized slate mantels, where shown, of the average value of $30, on first story, fitted for fire-places. Trap-door in ceiling of second story hall, to lead to attic.

Painting.—All exterior wood-work to receive a priming and two good and sufficient coats of boiled linseed oil and white lead paint, tinted a medium brown for cornices, friezes, corner boards, etc., and a light gray for all body work. Ceiling of porch sky blue. Yellow pine oiled two coats. Sash drawn dark brown. Brackets picked out in these colors. Chimneys also painted; base and bands brown, body gray. Inside work of two shades; all stiles, rails, moldings, etc., a blue-white, and panels and body-work cream tints, in priming and two coats. Black walnut oiled and shellacked twice.

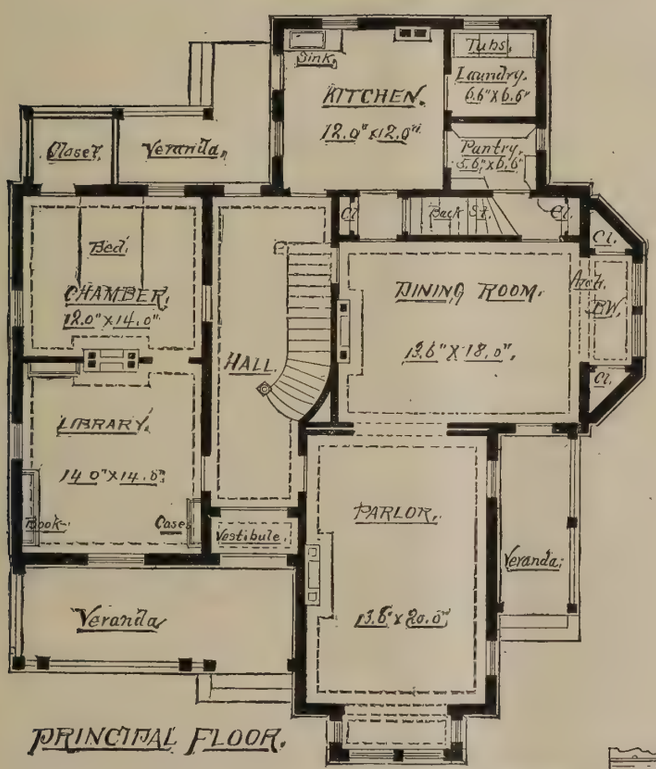
Work and material to be thorough and of good quality.

Plans and specifications are intended to coöperate so that which is necessary to the completion of the building, according to their meaning and intent, shall be supplied and done, whether the same be specifically mentioned or drawn, or not.

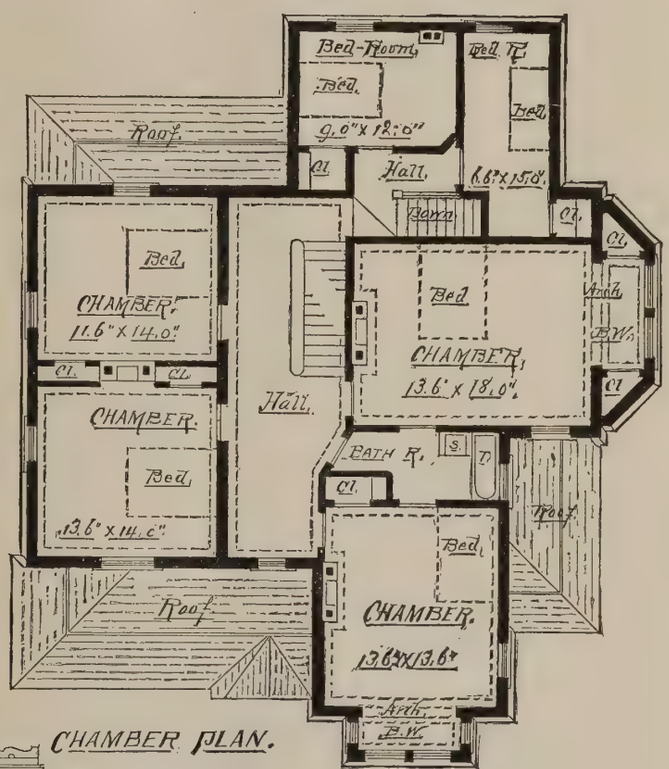
"THE GROWTH OF THE COTTAGE."

PART THREE
THE HOMESTEAD

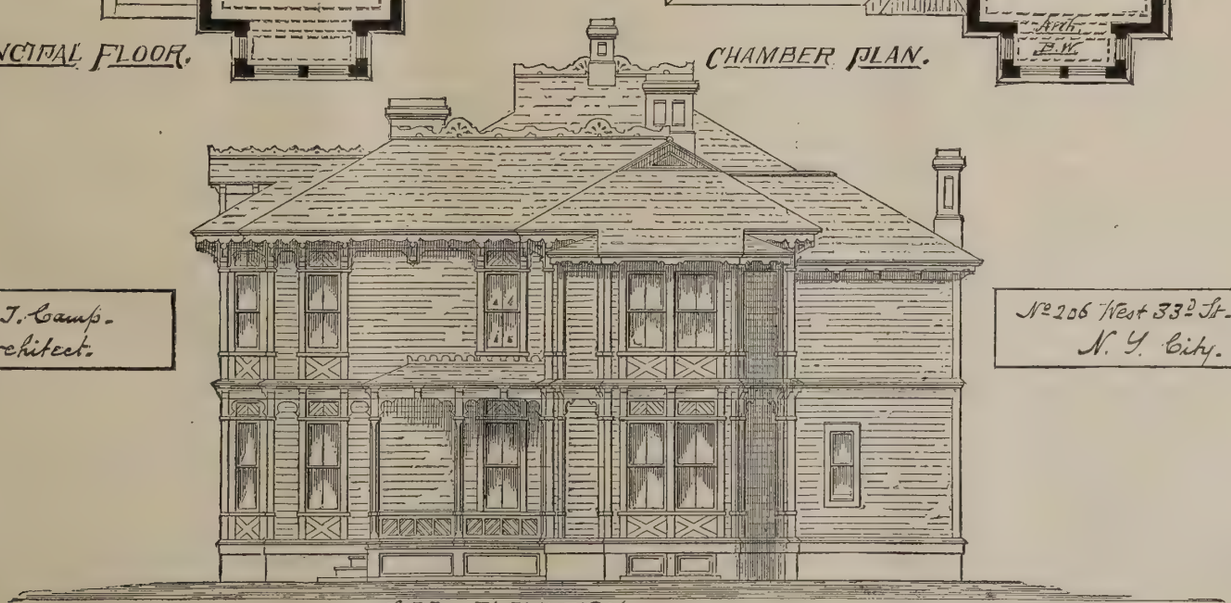
FRONT ELEVATION.



PRINCIPAL FLOOR.



CHAMBER PLAN.



SIDE ELEVATION.

Fred'k J. Camp.
Architect.

No. 206 West 33d St.
N. Y. City.

THE GROWTH OF THE COTTAGE. No. 3.—"The Homestead."

Priority in Telephone Matters.

Dr. Cushman, an able electrician, of New Lisbon, O., experimented twenty-five years ago with various kinds of telephones. He was recently interviewed in regard to his experiments, and the result, as published in the *Youngstown* (O.) *Vindicator*, again shows that nothing is more incorrect than to attribute the invention or discovery, as it now stands, entirely to any one individual. In regard to Dr. Cushman's claims, we extract from the paper mentioned the following statement made by him:

"In the year 1851 I was engaged in getting up some apparatus to protect telegraph instruments from the effect of lightning, when I discovered that I was receiving a sound as of peeping frogs some several miles distant. This led me to look into the matter, and between that year and 1855 I got up some experiments with practical results. In fact, in 1855 and 1856 we made practical use of what may now be called the electro-magnet telephone. I did not get articulation as well as it is now obtained by Bell and others. My apparatus was rude and cheap, and I used different kinds of heads or diaphrams.

"In those early days and years of telegraphing we did not have time to stop and talk to reporters, as now. I find, however, in an old scrap-book, an attempt to give a description of a system gotten up by myself, of reporting trains upon railroads. This was by using the whistle and bell at different points on the road. In this way each locomotive would report itself. I was about to say that the only thing the newspaper man was right in, was the manner in which I constructed lines in this reporting system—the magnet, with metallic diaphram enclosed in a box with ground wire line, and all that goes to make the Bell telephone, but in a rough state. In 1855 we used the same in principle, making such a practical use of it as to establish our claim as an original discoverer, provided no one had made use of the same prior to that date. The law does not compel a person to patent what he invents or discovers; but on the other hand it is a good defence to an action for the infringement of a patent, that the thing secured by the patent was not originally discovered or invented by the patentee, but had been in use anterior to the supposed discovery of the patentee. Neither would a mere change in form or proportion, or substitution of mechanical means or equivalents, in any one or all the elements producing the same result, constitute a substantial defence within the meaning of the patent law. In fact, in order for a plaintiff to recover for a violation of his patent, it must be shown that he was the original inventor in relation to every part of the work. The use we made was not mere experimenting.

"There has been a large number of patents issued on telephones. The Patent Office has had quite a harvest. The old stethescope, with a dried bladder drawn over the end and a string tied to the other, forming a string line from the house to the barn, as far back as 1834, has not escaped one or more claims among the batch issued."

To the above we may add that we found a description of a telephone in the German scientific journals in 1864. This was a form intended to convey musical tones, namely, the pitch and rhythm of sounds correctly. We had several of these instruments constructed, and experimented with them about that time in the Polytechnic Club of the American Institute. We made several improvements in the diaphram, and other details, and on two occasions read a paper respecting these improvements before the American Association for the Advancement of Science, and refer further, in this regard, to our back numbers, namely, page 129 of our May number, 1869; page 84, April number, 1877; and page 85, April number, 1878.

Dr. Cushman also expressed an opinion in regard to the success of the telephone companies now being organized in several localities in the United States as well as abroad. His opinion is so sound that we think no one will contest it. He says: "A good and useful application of the telephone, properly managed, if they start right, get arranged correctly, and do not undertake too much, will in practice be useful; but if they get confused in trying to use too many instruments upon one line, patrons will after a little become dissatisfied and lose confidence, and neglect to use the instrument, and the system will die out of use in time. On the other hand, if they are properly organized and trained, the instrument holders will succeed. However, time and experience will develop more upon the subject."

Granite Rock.

Granite consists of a mechanical mixture of three kinds of rock, in variable quantities. These are, quartz, felspar, and mica; quartz is also called silica, and is a compound of the element silicon with oxygen; the pure sand found on the seashore is this silica, disintegrated by the action of heat and cold, rain and frost, and finally, the action of the waves. It is the strongest ingredient in granite, and pure white sand is usually nothing but finely pulverized silica.

Felspar is a compound of silica with alumina and potash or soda, and therefore its chemical name would be silicate of alumina and potash. It is less resistant than pure silica, and when disintegrated becomes so finely divided that it is entirely washed away by running water, and at places where the water becomes stagnant it is deposited at the bottom in the form of a layer of clay, colored more or less dark by impurities in it. This clay is used for pottery and when pure and white is the kaolin or porcelain earth. Pipe clay is a white variety of the impure article.

Mica occurs in scales in the granite, and is a very complex compound, and at the same time very remarkable for its fire-resisting qualities. It is often found in large plates, which, being almost as transparent as glass, are used for windows in stoves and fire-places, for lamp chimneys, etc. It is a material similar to asbestos, with the difference that it is found in very thin plates, while asbestos is found as fine fibers.

Between the particles described, and which constitute granite, the microscope reveals, when it is cut into quite thin layers, very small spaces containing a little pure water, which fills only a part of the vacant space, but by a heat of 680° Fah. will fill the space entirely. The vacancies sometimes constitute five per cent of the bulk of the rock, and there may be a thousand million of them in a cubic inch. The veins of granite are a proof of an inner hot nucleus under the solid crust, showing the position of old vents. In the Western States and Territories abundant evidence of these vents is found. The three great classes of rocks in the earth's crust forming the land may be divided into the igneous, which is the oldest; the sedimentary, such as clay, formed afterward by the action of water upon the material of the former; and the organic, to which belongs chalk, fossil earth, coal, peat, humus, and all remains of organic nature in a fertile soil.

New Publications.

Draftsman's Manual. By F. T. Camp, Architect, New York.

This little publication, of which the value is in a reverse proportion to its small, unpretending size, fills a real want, which we especially appreciate, as it fully answers the question which has so often been asked the editor of the Manufacturer and Builder—"How can I learn architecture?" The book is full of hints to such inquirers, who can do no better than procure it, when they will find all their questions (with others which they ought also to ask, but do not through fear of exposing their ignorance) fully answered.

The author gives in his preface a sentence which we cannot forbear copying, as it is so very much to the point, and agrees with our personal experience. He says: "The query generally runs, 'I want to learn architecture;' a term often much broader than the real intention in the majority of instances, as the ambitious ones only mean that they want to learn how to make plans, sections, elevations, and details. They do not really want to go through the course necessary to thoroughly inform them as to the history of architecture; the styles—classic, Gothic, and Renaissance; but they think that the draftsmanship necessary to enable them to draw plans, etc., of every-day city and country houses, is architecture, and so they want to 'learn' it."

The book treats in successive chapters on drafting instruments and their use, on exteriors, on planning and drawing them, on elevations, on tracing and inking, etc., while it closes with some sensible suggestions and a list of books useful for the student of architecture.

The price of this valuable little work in pamphlet form is 25 cents, or, bound in cloth, 50 cents, at which prices we are prepared to supply it.

Fuel; its Combustion and Economy. By D. Kinnear Clark, C.E. New York: D. Van Nostrand.

This publication consists chiefly of abridgements of the "Treatise on the Combustion of Coal and the Prevention of Smoke," by C. W. Williams, and the "Economy of Fuel," by T. Symes Prideaux, while the editor has added the recent practices in the combustion and economy of fuel—coal, coke, wood, petroleum, etc. The principles and employment of powdered fuel and gas furnaces, which he calls "the furnaces of the future," are treated at considerable length, and this rightly, as they are very important in the practical arts.

It is a fact that in Siemens' gas furnace the four elements of success are completely effected. These elements are: Fuel gasefied, spare heat economized, air heated, and intermixture of the elements.

It is very gratifying to find that valuable books of practical utility, based on sound scientific principles, are becoming more and more accessible to those interested. The result can only be highly beneficial to both the profession, and the public who enjoy the benefit of professional knowledge.

Atwood's Revised Rules of Proportion. Compiled and Original, and Adapted to Modern Practice. By D. T. Atwood, Architect. New York: Bicknell & Comstock.

The author of this work has become well known by his "Country and Suburban Houses," "Modern American Homesteads," and as the designer of "Woodward's Country Homes." He is especially fitted to write authoritatively on this subject, as already in 1861 he had completed the system of proportioning the principal parts of city and country houses, which he six years later brought before the profession, encouraged by the fact that he had constantly used it up to that time in the mechanical execution of designs, which is his specialty, and that during all that time he did not find it necessary to make or suggest any material change.

The first edition of this work, issued in 1867, having been exhausted, a second edition, with seven additional plates, has just left the press. We consider it one of the most valuable books for architects.

Common Sense in Church Building. By E. C. Gardner. New York: Bicknell & Comstock.

The author of this book is known as the author of "Homes, and How to Make them," "Illustrated Homes," "Home Interiors," etc. The book is written in the form of letters of Job, Ichabod Long, Caleb Carter, and other fictitious personages, to the architect, and the architect's replies and explanations of his plans, seven of which illustrate the neat little volume. Finally the book closes with a first and second appendix, in which the architect's views are fully set forth in very spicy accounts of incidents connected with churches and church-going people. The book, besides being instructive, is very entertaining reading, and we commend it highly.

Geyer's Stationer's Illustrated Catalogue. Compiled by Andrew Geyer. Published by M. Shirley Geyer, 60 Duane street, New York.

This quarto volume, which costs $1.50, contains 1,500 illustrations of articles in the stationery trade as at present conducted in this city. A very convenient alphabetical index and list of advertisements and catalogues follow the title, and in further perusing the volume, one cannot help being astonished at the multitude of articles which at the present day make up the stock-in-trade of a stationer's store, including not only note books, paper, pens and inks, but picture frames, mirrors, rules, balances, knives, presses, brushes, paper files and weights, children's toys, bows, arrows and targets, etc., etc., and—corkscrews.

Genesis I., II. An Essay on the Bible Narrative of Creation. By Augustus R. Grote, A.M. New York: Asa K. Butts.

This essay gives the first two chapters of the book of Genesis in the original language in which it was written, and an English translation side by side. The latter is more literal than the King James' version, ordinarily accepted, while the author forcibly brings forward the difference between the Elohistic and Yahvistic accounts, the latter of which begins with verse 4 of chapter ii. This is followed by a chapter of literary criticisms, and another containing the testimony of archæology, parallel myths, testimony of facts, conclusions, and philosophy. We recommend this publication to all who search for truth.

PAMPHLETS RECEIVED.

We are indebted to the American Institute of Mining Engineers for the following papers: The Hygiene of Mines, by R. W. Raymond, Ph.D., New York; A Direct Process of Copper Smelting, by H. M. Howe, A.M., M.E., Boston, Mass.: Note on the Zinc Deposits of Southern Missouri, by R. W. Raymond, Ph.D., New York, Washing Phosphoric Pig Iron for the Open-

Hearth and Puddling Furnaces at Krupp's Works, Essen, Germany; An Autographic Transmitting Dynamometer, by Wm. Kent, M. E., Pittsburgh, Pa.; Experiments with Charcoal, Coke and Anthracite in the Pine Grove Furnace, Pa., by John Birkinbine, Pine Grove, Pa.; Recent Improvements in Concentration and Amalgamation, by John A. Church, E. M., Ph. D., New York; Relations of Sulphur in Coal and Coke, by Dr. J. P. Kimball, Lehigh University, Bethlehem, Pa.; Proceedings of the Montreal Meeting, September, 1879.

The Iron and Steel Works of the United States, published by the American Iron and Steel Association, Philadelphia.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2550) Effect of the Atmosphere on Falling Bodies.—Does the density of the atmosphere affect the velocity of falling bodies?—G. T. B., Newark, N. J.

(2551) Advice in Regard to Marriage.—As a man of experience, and a physician in whom I have confidence, I ask if you would advise me to marry. My circumstances are now such that I think I am able to support a wife; however, I will have to practice economy, such as giving up smoking expensive segars, attending the club, going out with my friends, etc. Now, which is best, to live in comfort and pleasure, or assume the care of a family? I know there are advantages connected with married life, but do they counterbalance the sacrifices?—One of Your Old Students, New York City.

(2552) Cerulein.—There is a new beautiful green anilin compound, used for dyeing. Can you inform me what it is, and how it is used?—T. L., Hicksford, Va.

(2553) Yellow N.—What kind of paint is the yellow N, said to be very intense, and lately invented in France? Can it be used for water or oil colors? Please inform me for what it is used, and how.—G. M., Freeport, Pa.

(2554) Taming Horses by Electricity.—It seems to me that I read in your journal a report that a method had been invented to tame horses by electricity. How is it done? Would not Mr. Bergh object to it as cruelty to animals?—M. O. K., New York City.

(2555) Greatest Hight of Balloon Ascent.—I have heard it asserted that balloonists have ascended 150 miles, by carrying with them a supply of air in a bag. Is this true? I supposed that at 40 miles the air was so rarified that no one could live at so great a hight.—C. R. A., Brooklyn, N. Y.

(2556) Aerated Water.—A few weeks ago our new water works were completed, the basin filled, the water turned on, and things seemed to go all right; but within a few days the water, when drawn, has a whitish or milky appearance. When first put into a glass, it begins to clear from the bottom, leaving a whitish scum on top. The water is pumped from the Ohio river. The street mains are of iron, and lead pipe is used in the houses. Will you please inform what the cause is of the water having this appearance.—W. L. C., East Liverpool, O.

(2557) Blackboard Against a Wall.—Will you be so kind as to tell me what kind of cement to put on a plastered wall that will answer the purpose of a blackboard in a school-house.—A Reader, Cohoes, N. Y.

(2558) Bending Wood without Steam Heat.—I have seen plow handles bent by steaming them, but understand that in Germany wood is bent without being steamed. If this is so, it would be a great saving in cost, Can you inform me how it is done?—S. D. N., Bay View, Mass.

(2559) Rough vs. Smooth Pulleys.—A machinist tells me that a belt will slip less on a pulley that has not been turned than on a very smooth one. Is that correct?—M. R. A., Bristol, Conn.

(2560) Protection Afforded by Copyright.—Observing that your columns abound with answers to all reasonable questions, I take the liberty of asking you for information in reference to the extent of protection which a copyright affords to publishers or compilers of books of recipes and formulas for medicines and the various compounds used in the arts and common industries of every-day life. I frequently see recipes just alike in different books, others very slightly varied, and again they are advertised for sale, though contained in a copyrighted book.—C. P. W., Manchester, N. H.

(2561) Patent for Well-Known Devices.—Can a compound be patented after it has been published in the papers?—C. P. W., Manchester, N. H.

(2562) Selling Copyrights of Published Recipes.—Can papers that first publish recipes sell to any person the sole right to publish them in book form, and to copyright them?—C. P. W., Manchester, N. H.

(2563) Right to Forms and Recipes.—If a person publishes a book of forms and recipes gathered from the news and scientific papers, has he any right or claim to the use of the recipes more than any one else, beyond the benefit which the copyrighted name of his book affords him?—C. P. W., Manchester, N. H.

(2564) Jacobs' Lithogram.—It appears that even a patent does not protect the manufacturer of a valuable compound. Jacobs' lithogram is imitated and the recipe sold in defiance of him.—C. P. W., Manchester, N. H.

(2565) Copyright vs. Patent Right.—Does a copyright secure to a publisher the sole right to make and sell his compounds, even though he originated or bought each one of them? It appears to me they are imitated, however imperfectly, and sold and published, by any one so disposed, with impunity.—C. P. W., Manchester, N. H.

(2566) Manufacture of Steel Pens.—Can you give a concise description of the manufacture of steel pens?—D. S. S., Potsdam, N. Y.

(2567) The Hottest and the Coldest Spots on Earth.—Where are the hottest and coldest places on the earth?—T. M., Bardwell, Ky.

(2568) Case-Hardening Recipe,—If you will be kind enough to give the best recipe for case-hardening, you would no doubt confer a favor on many of your readers, who are, like your subscriber,—A Mechanic, Ebensburgh, Pa.

(2569) Staining Pine Wood.—Can you inform me how I can stain pine wood so as to give it the appearance of black walnut?—T. S. A., Auburn, N. Y.

(2570) A Load for a Man.—How much can a man carry? I mean, not only like a soldier on a march, but also what is the heaviest load a man can carry for a short distance?—M. J. F., Farmdale, Ill.

(2571) Strength of Human Pull.—With what force can a man pull or push with his arms?—M. J. F., Farmdale, Ill.

(2572) Interior Hight of Domes.—The interior hight of the dome of St. Paul's in London is 112 feet. How does this compare with other similar domes in various parts of the world? Is not that of our Capitol at Washington much higher?—J. G., Camden, Del.

(2573) Losses by Fire.—What are the estimated losses by fire per year in the United States?—R. L., Delavan, Ill.

(2574) Influence of Motion upon a Projecting Power.—If a stone is thrown, or a ball fired from a ship in motion, has this any influence on the direction or velocity of the ball or stone? We have discussed this question from both sides, and cannot agree.—J. M., Kensington, Ill.

REPLIES.

(2550) Effect of the Atmosphere on Falling Bodies.—The resistance of the atmosphere retards the velocity of falling bodies considerably, and this in proportion to the velocity of the body and its size compared with its weight. During the first half second when a heavy body begins to fall, it drops through a distance of nearly 4 feet, and the effect of the air is scarcely perceptible; but during the second half second it should pass over 3×4 or 12 feet, and now the distance fallen through is less. During the third half second it should fall through 5×4 or 20 feet, and during the fourth half second through 7×4 or 28 feet, and so on. But in practice the distances fall short of these figures more and more, which are only nearly correct when bodies fall through a vacuum. Then the size of the body, in comparison with its weight, has a very great influence; when a body is compact and heavy, it undergoes a much less resistance than when spongy and light—it may, in fact, be made so large in proportion to its weight that it will fall very slowly. This is the case with feathers, snow, and fine powders; in fact, we may pulverize a heavy body so finely that it will float in the air in the form of dust; and when it is made fine enough we call another force into play—the adhesion of its particles to the particles of the air, and in this case it will not fall at all, but remain suspended. This is the case with the water particles in the clouds. We saw this beautifully illustrated at Niagara Falls; the water, ground, as it were, to dust at the foot of the great Horseshoe Fall, ascends as a spray, and in case the air is not so dry as to dissolve this spray and soon make it invisible, it will ascend higher and higher, and being carried off by the wind, will form a long line of floating clouds, extending farther than the eye can reach, but all being generated at the falls. Ordinary clouds, however, have of course quite a different origin than a mechanical grinding; it is the cold and diminished pressure which causes the air in the higher regions to become incapable of holding so much vapor in solution, as it were, therefore it releases the watery vapor, and the first appearance in the formation of water or ice particles, so fine that only the microscope can distinguish them. When these particles become so abundant that they touch and unite into large ones, they become too heavy to be kept up by adhesion, so they fall, and it snows on the mountain tops; when the particles fall down lower and reach a warmer atmosphere, the snow melts and it rains. All rains from high clouds are snow at first; from low hanging clouds they are rain from the beginning of their formation. If there was no atmospheric resistance to falling bodies, a fine rain would descend as fast as a heavy rain falling in large drops; when the drops are frozen as hail they fall faster, in proportion to their size; and, as is well known, when very large they often do considerable damage. We will only remind our readers of the old and well-known experiment with a piece of lead and a feather, enclosed in a wide glass tube about a yard long. When the tube is in its usual condition the lead will rapidly fall from one end to the other, while the feather falls very slowly; when the air is sufficiently exhausted, they will both fall together—the feather just as fast as the lead. This is the most conclusive practical demonstration that the air not only affects, but considerably retards the velocity of falling bodies, and this in proportion to their bulk as compared with their weight.

(2551) Advice in Regard to Marriage.—By all means marry. Think of old, childless bachelors; what is their condition? Better a thousand times the father of ever so many children. Never mind its cares; the pleasures of married life far surpass the drawbacks. We know this from experience as we have tried it twice, and like the second better than the first. But the best argument in favor of marriage is that recently given by a French savant, Dr. Bertillon, who has studied the statistics of every country in Europe. He comes to the conclusion that marriage is conducive to health, long life, and morality, and is, so to speak, a limited insurance against disease, crime, and suicide. He says that a bachelor of 25 has not a better prospect of life than a married man of 45; that among widowers of from 25 to 30 the rate of mortality is as great as among married men of from 55 to 60. Taking the French bills of mortality, he shows that while the annual death rate among married men between 20 and 25 years of age is rather under 10 per cent; 1,000, bachelors of that age die at the rate of 16, and widowers at the rate of 19 per 1,000. These figures apply to the whole of France, while taking Paris, it appears that the rate for men of between 20 and 25 years of age is 15.7 per 1,000 for married men, 27 for bachelors, and 32 for widowers. With advanced life the difference goes on increasing. With regard to crime, Dr. Bertillon asserts that offences against the person are 50 per cent less, and against property 45 per cent less among married men than among unmarried. The difference is still more remarkable among women, amounting to 250 per cent. The number of suicides is at the rate of 628 per million for widowers, 273 for bachelors, and 246 for married men. So much for your chances of being a good man and living to an old age in case you marry. But the great question is who to marry. This all depends upon quality of the wife you select, and in this no one can advise you. We can only say, do not be in a hurry, but wait until the proper kind of lady is met. We have a friend in Washington with whom we have been acquainted for twenty years; he was becoming an old bachelor, and often told us that he did not think he should ever marry, that he never saw a woman who he would like to have for his wife, and did not think he could ever make a wife happy, as from his long condition as a bachelor he had become full of angles and asperities, which in married life would have worn off, like a water-worn pebble. So years passed on, when, one evening he met a young lady who had just arrived from Europe. She was an original genius, like himself, and he fell deeply in love for the first time in his life, notwithstanding he was past forty. He is married now, is raising a very interesting family, and as happy as a man can be who has to support himself and family by his abilities.

(2552) Cerulein.—If you mean Cerulein, which is a new alizarin green, we can satisfy your inquiry. It is especially used for cotton twist. The mordant is a bath composed of 1 part Turkey red mordant oil and 18 parts of water. Age for half an hour, press and put into another beck, containing, to every quart of water, 100 grams of water, and from 30 to 35 soda crystals. Put in for half an hour and rinse. The dyeing beck should have water absolutely free from lime. When near the boiling point, add a solution of soap, and boil for ten minutes; rinse, and if necessary pass through a warm suds bath.

(2553) Yellow N.—This new color, introduced by a French house, is not a paint at all, but a dyestuff. It is no more intense than picric acid, but has a different shade—more like curcuma and quercitron. We do not think it is fit to be used as a paint, but is used on wool in the same manner as oranges and oceanilline. Very little sulphuric acid must be used in the beck, as an excess of it will precipitate the coloring matter. The best method for dyeing on cotton is to mordant with stannate of soda, pass through an alum bath, rinse, and then dye at 60° C. A little acetic acid, or acetate of alumina, is added to the bath.

(2554) Taming Horses by Electricity.—Mr. Bergh cannot object, as there is no cruelty in it; it only attracts the horse's attention by the strange sensation, which draws his mind from his intention to kick. It is similar to the old trick of putting a pea in the horse's ear and tying it there; the noise produced by it when he shakes his head so occupies the horse for a time that he forgets to kick. The electric apparatus referred to was invented in Brussels, Belgium, and is called the Engstrom bridle, after the inventor; it consists simply of a couple of reins, along which run conducting wires. At the ends of the reins a small electric battery is attached, which is entirely in the power of the experimenter. By pressing on a little knob the electric current acts on the corners of the horse's mouth, and after a few consecutive or intermittent gentle shocks the animal becomes perfectly docile.

(2555) Greatest Hight of Balloon Ascent.—The statement is untrue, and was probably founded on Jules Verne's "A Trip to the Moon," in which he gives an account of an imaginary voyage to that luminary. His heroes are fired, in a hollow projectile, from a big gun; they carry the air with them, the projectile being air-tight, and manufacture fresh air from chemicals according to their wants. An aeronaut soon reaches a hight where the air is so rarefied that it becomes unfit for breathing, and most men would faint at a hight of 20,000 feet. Guy Lussac, in 1804, ascended from Paris to a hight of 22,000

feet, or about 4 miles, and to the permanent injury of his health. Later, in 1862, Glaisher, of London, ascended to a hight of 29,000 feet. He first became paralyzed, then unconscious, and would have died had not his assistant opened the gas valve in time, thus allowing the balloon to descend, when he recovered. This is the greatest hight ever attained. The barometer recorded 9 inches pressure, or one-third of the normal pressure of the atmosphere, and it appears this is about the maximum that any man can stand.

(2556) AERATED WATER.—The cause of this appearance of the water is nothing but air, which becomes dissolved in it, probably from a kind of churning the water undergoes during pumping; or if it is not pumped up, air may be entrapped in the pipes, with which air it circulates. This air is kept in solution as long as the water is under pressure. When the water is drawn the pressure is removed, the air is set free, and shows itself in microscopic air bubbles, which gradually rise to the upper part of the glass vessel, and give the appearance you describe. The same thing is very common in the Brooklyn (N. Y.) water, which is pumped up, and there is nothing objectionable about it, as it is simply atmospheric air. The water is even more palatable, as water deprived of air by boiling has a flat taste, as almost every one knows.

(2557) BLACKBOARD AGAINST A WALL.—The very best thing is to cover the wall with plaster of Paris. As plaster of Paris alone sets too quickly to enable you to make a good job of it, it is better to mix some fine slacked lime with it. Mix the lime first with water, then mix the plaster with water also, and work the two rapidly together, and put it on the wall after first wetting the latter. But perhaps it is better to employ a regular plasterer for this, who can make you a surface as level and smooth as Bristol board. After the wall is well set and dry, paint it with boiled linseed oil and lampblack, and after this give it a coat of what may be called artificial slate, made by mixing shellac varnish with lampblack and a very little of the finest emery or pumice stone, so as to render the surface a little gritty, that it may be written on with chalk. Without the addition of some gritty substance it would be too smooth to write on; but if you put in too much, the surface will be so rough that it is difficult to obliterate the chalk marks. When the Cooper Union was organized in 1859, we had several thousand square feet of hard finished wall treated in this way, so as to change it into blackboards for the several classes in mathematics and mechanics, taught in some eight or ten different rooms, and for the classes in perspective and architectural drawing, and these blackboards gave great satisfaction. After a few seasons the coat of artificial slate had to be renewed, as in time it wears too smooth and loses its deep black color.

(2558) BENDING WOOD WITHOUT STEAM HEAT.—The method you refer to is only adapted for thin boards, such as sieve hoops. Two rollers are employed in the operation, one above the other, and having different velocities, so that the upper one acts by holding back while the lower one extends the wood fibers. The upper roller is fluted, while the under one is smooth; if two smooth rollers were used a very much greater pressure would be required; but the fluted roller compresses the fibers, while the smooth one extends them. When the board, thus bent, leaves the rollers, it is fastened in the mouth of the sieve.

(2559) ROUGH VS. SMOOTH PULLEYS.—The apparent advantage of a rough pulley over a smoothly turned one is counterbalanced by the suction of the belt on a smooth pulley, and the wearing of the belt when it slips on a rough pulley, while the slipping on a smooth one is harmless. Hence pulleys are always turned off and never used rough; not to speak of the variable tension of a pulley which has not been turned off. If the belt is too narrow, and moves too slowly for the power to be transmitted, it will slip even on a very rough pulley, and soon be ruined. The rule for determining the velocity and width of a belt in order to transmit a given horse-power, is based on the proportion: *The horse-power to be transmitted, is to the width of the belt as the speed in feet per minute is to the constant number* 400. Calling the horse-power H, the width of the belt W, and the speed in feet per minute S, we have the proportion:

$$H : W = S : 400$$

from which follows

$$W = \frac{400\,H}{S} \quad \text{and} \quad S = \frac{400\,H}{W}$$

Which, transcribed into words, reads thus: *To find the width of a belt, multiply the horse-power with* 400 *and divide by the speed of the belt in feet per minute. To find the speed necessary for a given belt, multiply the horse-power with* 400 *and divide by the width of the belt.* We may add to this that the proportion also gives the equation:

$$H = \frac{W \times S}{400}$$

Which means that, *to find the horse-power which a given belt, moving with a given velocity, can transmit*, we multiply the width with the velocity in feet per minute, and divide by the constant number 400. We must add to this that to prevent slipping, the belt should be made to embrace as much of the pulley as circumstances allow, and should in no case move with a less velocity than 200 feet per minute. The best velocity is from 300 to 400 feet, while 500 to 600 feet should not be surpassed, except in very large benches, where it may reach as high as 1,500, 2,000, and even 2,500 feet. When pulleys are connected by wire ropes, however, the velocity may vary from 1,000 to 5,000 feet per minute. It follows from all the preceding that the danger of slipping diminishes in ratio to the increase in width of the belt and its velocity, while with a sufficient tension the air, as it were, is squeezed out between the belt and a smooth pulley, causing a kind of vacuum adhesion and many more points of contact, so that actually there ought to be less danger of slipping with a smooth pulley than with a rough one, provided the pulley and belt are not intentionally made very smooth by such substances as graphite or soapstone.

(2560) PROTECTION AFFORDED BY COPYRIGHT.—The copyright of a book does not give any right to matter contained therein which is not new and original. As by far most of the published recipes are old, they go the rounds of many books and papers; any one can republish them, and this is being done continually. If you only adopt a new, attractive title, you can use any number of old recipes and devices to be found in the papers.

(2561) PATENT FOR WELL-KNOWN DEVICES.—If a compound or invention has been published, it has become public property and cannot be protected by patent.

(2562) SELLING COPYRIGHTS OF PUBLISHED RECIPES.—When you publish a book of recipes you can copyright the title, but you cannot copyright the entire contents. The law on copyright even provides that extracts may be published by reviewers. If the paper in which the recipes are first published is copyrighted, and the recipes are new and original, it may be risky to republish them; but there are now so many recipes published over and over again, that there is rarely one which has not become public property.

(2563) RIGHT TO FORMS AND RECIPES.—Almost anything published in the news and scientific papers is public property, and recipes so obtained can be used by any one, unless there is some recipe among them covered by a special patent. Consequently, the publisher has no other claim except the copyright of the name of his book.

(2564) JACOBS' LITHOGRAM.—This is for the simple reason that Jacobs is not the original inventor of the lithogram, and that if he obtained a patent on some modification of the process, it is worthless, as the original inventor was Ferdinand Stein, of Vienna, who sold recipes for this process six years ago.

(2565) COPYRIGHT VS. PATENT RIGHT.—It appears that you confound the copyright, which gives the exclusive privilege to sell a book or publication, with the patent right, which gives the exclusive privilege to use and introduce your invention. In the latter case you ought to mention in your publications respecting it, that it is patented, mentioning the date and number of the patent. This must also be done in regard to every specimen you sell of the preparation or device, otherwise you endanger your own interests. A mere copyright is no protection at all for a patentable device.

(2566) MANUFACTURE OF STEEL PENS.—It is necessary to use the very best kind of steel—that made from Swedish iron is usually employed in the manufacture of steel pens. The metal is first rolled, while red hot, into plates about 3 feet long and 4 inches wide. The plates are annealed, and all oxid is removed from their surfaces by immersing them in dilute sulphuric acid. The plates are then rolled into sheets the thinness of a steel pen; these sheets are cut into pieces, and are afterward punched out into flat pieces the size and shape of the future pen, care being taken in doing this that the length of the pen should correspond with the fibers of the metal. The hole at the end of the nib, and the side slits that give flexibility to the pen, are now made, and are cut with a small press. Although in its present state the steel is so soft that it may be bent between the fingers like lead, yet it is not sufficiently soft for the process it has to undergo before it assumes a perfect state, and therefore is again softened by annealing. This is performed by exposing it to heat, and allowing it to cool slowly. When this is done, the name or trade-mark of the manufacturer is stamped on the metal. The pen is still flat, but is now curved. For this purpose it is placed in a groove, beneath a press, and a convex die descending powerfully upon it, bends the metal into the required shape. The pens are hardened by exposing them to a white heat and then suddenly throwing them into a vessel of oil, any oil that may adhere to them being afterwards removed by shaking them in a cylinder. It is now necessary to temper the metal to the degree of elasticity required for writing. For this purpose the pens are placed in a cylinder, closed at one end, which revolves over a charcoal fire; this process being not unlike the manner in which coffee berries are roasted. By being exposed to this heat the surface of the steel changes its color; it becomes a gray, a straw-color, a brown, and, as the process is continued, a deep blue. The pens are then placed in a metal cylinder containing the powder from broken crucibles, sand, etc., and caused to revolve rapidly, by which means the surface of the metal becomes perfectly clear and bright. After this the backs of the nibs of the pens are ground. This is done by applying them for an instant, one by one, to the surface of a revolving wheel. Then the slit between the nibs is cut by means of a small die press. The steel pen is now finished, and only requires to be colored brown or blue, by exposure to heat, until it assumes the tint desired. The pens are then varnished by being dipped into shellac dissolved in spirits of wine or naphtha, and exposed to a moderate heat to dry them.

(2567) THE HOTTEST AND THE COLDEST SPOTS ON EARTH.—One of the hottest regions on the earth is along the Persian Gulf, where little or no rain falls. It is more uncomfortable from the fact that at Bahrin the arid shore has no fresh water; yet a comparatively numerous population contrive to live there, thanks to the copious springs which break forth from the bottom of the sea. The fresh water is got by diving. The diver, sitting in his boat, winds a great goatskin bag around his left arm, the hand grasping its mouth; then he takes in his right hand a heavy stone, to which is attached a strong line. Thus equipped he plunges in and soon reaches the bottom; instantly opening the bag over the strong jet of fresh water, he springs up the ascending current, at the same time closing the bag, and is helped aboard. The stone is then hauled up, and the diver, after taking breath, plunges in again. The source of the copious marine springs is thought to be in the green hills of Osman, some five or six hundred miles distant. The most uncomfortably cold place of which we have any account, is on top of the magnetic North Pole, north of our continent. Probably on the magnetic South Pole it is colder still, as when it is winter there the earth is at its furthest distance from the sun, while when it is winter at our North Pole the earth is nearer to the sun.

(2568) CASE-HARDENING RECIPE.—The main and best ingredient used for case-hardening is the ferrocyanid of potassium, usually called yellow prussiate of potash. It may be used in various ways; some make the iron object red hot, sprinkle the pulverized chemical upon it, and then plunge into cold water; others make a strong solution of the salt and plunge the hot iron into it; this gives only a very thin, hard coating. The best method of using it, is perhaps that of G. C. Roberts, of Brooklyn, N. Y. It is a little more troublesome, but gives a thicker hard coating. After polishing the surface, he glues to those portions of the objects which he wants to be case-hardened, a coating of yellow prussiate of potash; a number of coats are given, according to the degree of the case-hardening required. When the glue is set hard, the article is packed in powdered charcoal, heated to redness in a quick fire and maintained at that heat for half an hour. Then it is hardened and tempered in the usual manner.

(2569) STAINING PINE WOOD.—Put pulverized asphaltum into a bowl with about twice its bulk of turpentine, and set where it is warm, shaking from time to time until dissolved; then strain and apply with either a cloth or stiff brush. Try a little first, and if the stain be too dark, thin it with turpentine. If desirable to bring out the grain still more, give a coat of boiled oil and turpentine. When the wood is thoroughly dry, polish with a mixture of two parts shellac varnish and one part boiled oil. Apply by putting a few drops at a time on a cloth and rubbing briskly over the wood.

(2570) A LOAD FOR A MAN.—Some interesting results have just been published of experiments made in France, in regard to this very question. These may afford a satisfactory answer, and prove more reliable than we could give, as they are practically ascertained new facts. The maximum load for a moderate distance was found to be 319 pounds; but for a long distance, say a soldier marching on level ground, he could not carry more than 132 pounds, distributed over the body as knapsack, cartridge-box, musket, etc. If he carries this 7 or 8 miles for a day, it is equivalent to a good day's work. This is equivalent to 1,518 pounds carried a distance of 3,200 feet for a day's work. But if he ascends a ladder, like a hod-carrier, he can only carry 120 pounds continually, and will in a day carry only 1,230 pounds 3,200 feet high.

(2571) STRENGTH OF HUMAN PULL.—In regard to the effect and the velocity with which a man can produce by pulling or pushing with his arms, it has been found by the experiments referred to in the previous answer, that, under the most favorable circumstances, and for continuous work, an effect cannot be gained exceeding from 26.4 to 23 pounds raised from 1.8 to 1.2 feet per second, which is equivalent to about 4,000 foot-pounds raised one foot, or 4,000 foot-pounds, or one-eighth of a horse-power.

(2572) INTERIOR HIGHT OF DOMES.—The highest interior is that of the central part of the cathedral of Cologne, which is more than 150 feet—we have not the correct figures at hand. Then follows the Pantheon in Rome, 142 feet; the dome of the British Museum, 140 feet; St. Peter's in Rome, 139 feet; St. Maria in Florence, 139 feet; the Capitol at Washington, 135 feet 6 inches; that over the tomb of Mohammed in Bessapore, 135 feet; St. Paul's, 112 feet; St. Sophia's in Constantinople, 107; the great church in Darmstadt, 105. These are the highest domes we know of.

(2573) LOSSES BY FIRE.—The recorded losses for this year are $85,000,000; but as it is estimated that one-third of the actual losses are not recorded, the loss must be more than $100,000,000. The statistics of the last ten years show an increase in the losses by fire, even when not counting the great conflagrations; proving that our present system of building is far less safe than it used to be, especially when we take into consideration the great improvements in fire-fighting appliances. The principal cause of this increase in losses is the very high buildings, the upper stories of which are almost out of reach of the firemen, and even of their steam fire engines.

(2574) INFLUENCE OF MOTION UPON A PROJECTING POWER.—Most decidedly; the velocity of the motion of the ship must be added or subtracted from the stone or ball, in proportion as it is projected forward or backward. If thrown sideward, the stone or ball will move in an oblique direction, which is determined by the diagonal of a rectangle, of which the velocity of the ship is represented by one side and the velocity of the stone or ball by the other.

THE MANUFACTURER AND BUILDER

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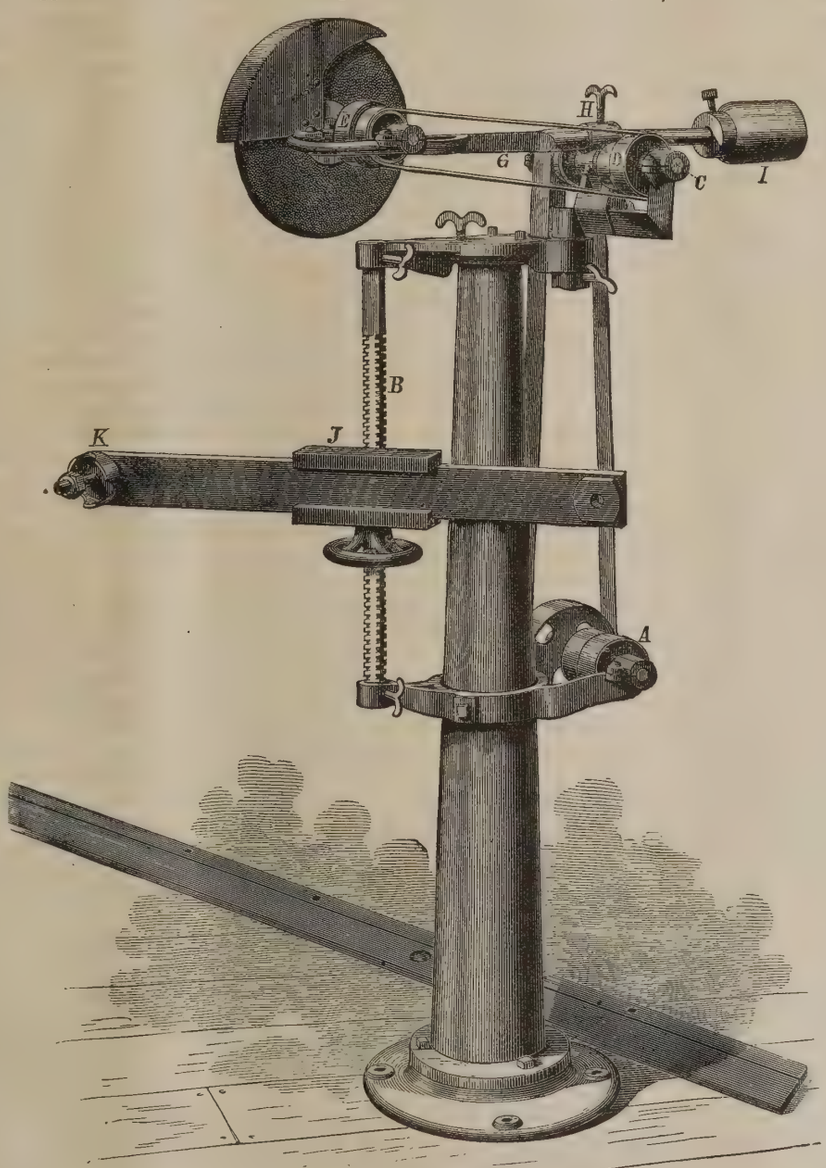
The Densmore Saw Gummer.

The machine represented in the accompanying engraving shows the application of the emery wheel to the functions of a saw gummer. It possesses certain novel features of construction, enabling the wheel to be set to any angle that may be required in the work for which it is designed. As shown in the cut, the working parts of the machine are supported on the cross-head of the strong upright column. The driving pulleys, shown at A, attached to the center of the column and journalled between the arms of the lower cross-piece, transmit motion to the pulley E on the emery wheel shaft, by means of the small shaft C and pulleys D on the upper cross-head. The shaft C passes through a metallic block F, which fits loosely upon it, and which is bored to receive the arm G which supports the wheel. This arm is movable in the block, and can be adjusted and fastened in any position by the set-screw at H. When a circular saw disk is to be gummed, it is attached to the end K of the horizontal saw bar, which is then fastened to the stock J in such a position as to bring the saw-teeth properly under the emery wheel. The wheel having been fastened to the proper angle to the tooth by rotating the arm G in the block F until the right inclination is obtained, the stock is then adjusted by means of the elevating screw B to bring it to the proper hight, and the arm G is then brought down in front until the wheel is in the right position. The counterbalance I on the fore end of the arm carrying the wheel, enables the operator to elevate or depress the wheel with ease.

When a straight-edged saw is to be gummed, the blade is confined in a carriage, the wheel is properly set in relation to it, and the saw gradually carried forward by the carriage as each tooth is gummed.

This is one of the special tools manufactured by the Tanite Company, of Stroudsburg, Pa.



SAW GUMMER.

Hanging Shafting.

Jesse Lord gives the following hints on putting up the shafting in a machine shop: "When a proper building is provided, the hanging of the shafting should be intrusted only to a competent man—one who can previously plan the location of every machine on the floor, and the position of every pulley on the main line, if not also on the counters. Then he can know just where his hangers or brackets should be to best sustain the weight of the heavy pulleys, and the proper intervals between them, to prevent swagging of the shaft when at rest and its springing when in motion. If the shaft is supported by brackets on posts, an approximation to a level may be made by stretching a chalk line along the posts and designating the top or bottom of the brackets, or the center line of the shaft on the posts. Although the line, if stretched a considerable distance, will sag some, it will be sufficient guide for the boring of the bolt holes. The rectification of this line can be effected, after the boxes are placed, by means of a water level, a sighting level, or some similar device, the eye being entirely reliable in testing a right line, although not trustworthy in testing a level. To ascertain a level, a straight edge of good seasoned pine, planed accurately on both edges, strictly parallel, and wide enough to prevent sagging and long enough to reach from one box to the next should be provided. In use, one edge should be rested on the boxes, and on the other should be placed a spirit level. This is a simple but effective device. Of course it is equally applicable to hangers and brackets. Shims for levelling down hangers should be of wood, not leather, a yielding material; not iron wedges, generally made too narrow to give good bearing. Probably nothing is better than seasoned rived cedar shingles, which are almost as hard as horn. Bolts to hangers are perhaps necessary for very heavy shafting, but they have been largely superseded by lag screws, or, as some call them, coach screws. If bolts are used, the heads should be slightly convex, strengthened by washers under the head, and both washer and head partially sunk into the floor. When lag screws are used, the holes for their reception should be bored only as large as the core of the screw, leaving the thread to make its own way through the wood. Neglect of these duties will surely cause waste and expense."

Blowing off Steam Boilers.

A French essays contains the following on blowing off steam boilers: Those who possess externally fired boilers, working only by day, have all observed that, the fire being covered by night and the doors closed, the pressure rises during the night, often sufficiently to open the valves. This shows that the masonry, being at a much higher temperature than the boiler which it envelops, imparts to it some of its heat. The same effect of heating the boiler is produced, to a less degree it is true, but nevertheless to some extent on the outer jacket of internally fired boilers. It is, consequently, injurious to empty boilers soon after having stopped them, because after emptying the plates would be heated by the action of the masonry. It is well to admit a current of air through the flues some hours after the stoppage of the generator, and not to empty it before the flues become cooled to a temperature below 150°. When the flues are not too hot, no serious inconvenience is experienced in emptying the boiler under pressure—we do not say at high pressure, as for a boiler the pressure of which would be 11 pounds, the temperature of the water being 150°, a great quantity of steam would be generated during the process of emptying; we think that at a pressure of about 2 pounds the boiler could very well be emptied. In internally fired boilers, as there is no masonry to cool in

the furnace tubes, it would be well to admit the current of air intended to cool the masonry behind the boiler, as in this case the furnaces would be cooled more rapidly than the jacket. We have sometimes seen owners empty their boilers almost immediately after the fires had been extinguished, clean them with cold water as soon as they were empty, and keep up a current of water so that the workmen might work there. Boilers of small dimensions sometimes resist such treatment, but in large boilers unequal contractions must take place, which burst the rivets.

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Vol. XII. No. 2. TWELFTH YEAR.

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Special Edition to Wood-Workers and general Steam Users.

The great success that attended the issue of the special editions of our journal last year, to saw and planing mills and general wood-workers, has encouraged us to publish another extra, and we have decided to devote our April number to this purpose. We propose to publish ten thousand extra copies of that number, in addition to our regular issue, which we shall send to leading wood-workers and general steam users throughout the country. The attention of advertisers is called to this announcement, and our experience leads us to believe that they will not be slow in appreciating the benefit to be derived in being represented in this special spring number. The satisfaction that was so universally expressed, by those advertisers who favored us with their patronage in our previous extra numbers, gives us reason to expect a large representation in our April special.

The Chambers Humbug Furnishes the Text for a Short Sermon.

Our excellent neighbor, the *Popular Science Monthly*, finds in this impudent piece of charlatanry, whose stock in trade is public ignorance and credulity in matters dealing with the very A, B, C's of natural philosophy, the text for a few well-chosen remarks on the inefficiency and impractical character of the training given in the common schools, which meet with our hearty endorsement. The *Monthly* traces the origin of much of this inefficiency and worthlessness to the silly affectation of many pseudo-educators that it is a mark of devotion to pure scholarship to ignore the practical and the beneficial in education; and then proceeds to show how this idea, which may do little or no harm as the guiding principle of a few exceptional scholars, may be prostituted to pernicious ends by the homunculi who ape them.

"Knowledge," says our neighbor, "is for guidance, and education for the more intelligent direction of the energies, for the mass of mankind live in a world of action and struggle. But this principle is far from being recognized in current education. The lower schools seize upon the higher ethics of university study and pervert them into a defence of their own bad practices; they teach worthless things, on the pretence that the *kind* of knowledge is of but little account, as education is only concerned with mental training. The crudeness and inefficiency of teaching are excused upon the plea that mental discipline is the thing aimed at in study. Our whole school system is imbued with this vicious fallacy, which is the great obstacle to rationalizing school methods. The knowledge that is of most worth, is either not taught, or is taught so loosely and carelessly, that it is of but little practical use, and the consequence is that our boys are turned out into the world so ignorant and incompetent that they are defenceless to protect themselves from the grossest impostors. To what end is a community, filled with colleges, high schools, and common schools, upon which millions of dollars are spent, when their graduates go out to become the ready prey of charlatans and sharpers, who can enrich themselves by pushing the most absurd and preposterous projects?"

These words have the ring of genuine metal, and we heartily echo them. The case, bad as it is however, is by no means so dismal as it was some years ago, when all our colleges and higher schools compelled their pupils to follow the same old, inflexible, scholastic curriculum that had been followed without variation since the time of the Crusades, we were about to say, but we will say, almost as long as Methuselah is alleged to have lived. But the marvelous progress of the physical sciences, and the numberless ways in which they effect the betterment of the moral and physical condition of mankind, have not been entirely fruitless of results in forcing thinking men to the conclusion that a knowledge of these things, so important in the affairs of the world beyond the school, should be taught there. With the advocates of the old scholastic system strongly intrenched in possession of the field, it can hardly be expected that such radical innovations as the friends of science are striving for should be admitted without a struggle. But a decided change for the better, in obedience to the practical requirements of the times, has already been made by the best colleges of the country, and by and by we may expect to see the animus of this innovation vitalizing every school in the land. An extract from an address on this very topic, delivered some time ago by the writer, may not be inappropriate in conclusion, namely:

The necessity of training men and women to become intelligent masters of the principles underlying the practice of the useful arts; of teaching them the languages, the history—social, political and industrial—of the world we live in; and the relation of the thousand and one things with which the real world—the world of living workers, in agriculture, trade, commerce and manufactures, is interested; the necessity of doing this is being reluctantly admitted. The consequences of this admission, recent though it has been, have been wholesome and encouraging, though the changes in our educational systems which it has forced are yet far from being as complete and fundamental as the advocates of the new education would make it. But the race of educators who taught their pupils to see in musty Latin and Greek histories and poems especial virtues for disciplining the mind which do not exist in Shakespeare, Schiller or Goethe, and in the comprehension of the vagaries of ancient philosophy, exercises in intellectual gymnastics vastly more improving than the comprehension of the laws of nature, under which they live and move and have their being, are slowly but surely giving way before the pressure of public opinion, which demands the reconstruction of these fossilized, medieval methods to meet the requirements of the day for learning of a useful kind.

The needs of America for this kind of education are larger and more imperative than those of other countries. We need educated skill of this kind in every department of industry; men who can rationally direct the tillage of our countless acres of productive soil now lying unproductive; and the rational cultivation and utilization of our forests, that the ignorant impoverishment of the former, and the improvident and criminal destruction of the latter, may not, despite the exhuberance of nature's bounty to this, the richest of her continents, cover her face with the widespread desolation that has converted so many of the fairest garden spots of Asia and Europe into arid deserts; men who can direct us to tap, with the magic wand of science, the rocky ribs of our hills and mountains, and force them to disgorge their hidden treasures; we need designers and constructors who shall supply to skilled workmen in other fields of industry the tools and machinery that will multiply their productive powers a thousandfold, so that the products of multifarious industries may be placed within the reach of the humblest and poorest.

What shall we say then of the colleges—and their number is legion—which, after four years of so-called training for life, turn out of their doors a helpless creature whose whole stock in trade consists in his ability to scan you a Greek verse, or to give you on demand a Latin quotation "to point a moral or adorn a tale"—a walking encyclopædia of moods and tenses, and suffixes and affixes, who, when thrown upon his own resources, finds himself utterly helpless and unprepared to take

part in the real struggle for existence, in that busy world of industry that knows nothing, and cares less to know, of dead languages and histories?

A Coal Gas Explosion on an Ocean Steamer.

The violent explosion in one of the coal bunkers of the steamship "Greece," which occurred a few days ago as the vessel was making into her pier, must call public attention to another and unlooked-for danger attending the ocean passage. To the perils of storm, fire and collision, the passenger must add the terrible possibility of being blown to "kingdom-come" by the "fire damp" of the coal mine under his feet. The particulars of the accident in question, which are given briefly in what follows, only serve to excite our surprise that they are not more frequent, seeing that the accidental circumstances that caused it are of such a nature as to render its frequent recurrence not at all unlikely.

The account herewith given is taken from the columns of the daily papers, and is no doubt substantially correct. The accident was bad enough as it was, having been attended with the loss of several lives and the maiming of several persons besides; but when the frightful possibilities are considered of what might have occurred, had the explosion taken place at any other time and place than when and where it did, the affair, unfortunate though it was, may be looked upon as an exceptionally fortunate escape from a far more serious calamity. The circumstances of the case, as told in the daily journals, are substantially the following:

"The explosion in the third coal bunker in the lower hold of the steamship 'Greece,' in her berth at the foot of First street, Hoboken, N. J., it is said would probably have been attended with an appalling loss of life had the steamship been made fast to the pier. The crew were forward and aft, warping her in, the saloon passengers were well aft of the waist, crowding at the shore rail to exchange greetings with friends waiting on the pier, and the steerage passengers, 120 in number, had been mustered forward by Custom House officers, in readiness to step on board of the Castle Garden boat. Had the vessel been attached to the pier, the deck near the third hatch, from which burst out a great mass of flame simultaneously with the explosion, would have been thronged with the friends of the saloon passengers, stray steerage passengers, and the crew. The force of the explosion was terrific. The upper deck was raised nearly three inches; the stout iron stanchions supporting the deck, although riveted by spikes several inches in length, were torn up, and in several instances were snapped in two like straws. The rivets were driven out of their sockets, and the fore-and-afters —great beams, weighing several hundred pounds—in the third hatch were tossed a hundred feet into the air; one fell into the water, and the other, descending in a curve, shattered the boom of the foremast and made a deep hole in the oak planking of the deck. The impact broke the beam in halves. Darting up the third hatch, the flames scorched and blistered all of the woodwork amidships. The intensity of the flames was so great that the wood-work shrivelled up like paper; then the flames spread forward, bursting up the first and second hatches, consuming the gratings in a minute."

The account from which we quote the foregoing then proceeds to detail the particulars of the killing and maiming of the half dozen unfortunates who happened unluckily to be in the part of the vessel that suffered from the explosion, and to narrate the doings and finding of the coroner's jury that was empanelled the ascertain the cause and fix the responsibility for the accident.

The captain of the vessel is reported to have asserted that the coal with which his vessel was supplied, was a South Wales coal, not of a notably gas-producing kind, but excellent for steaming purposes. An explosion of coal gas in a steamer's hold is uncommon, he added, but not unprecedented. A few years ago a steamship plying between England and Canada, caught fire after an explosion that killed a large number of her crew and passengers, and was scuttled and abandoned at sea. It is a danger that can be arrested only by the utmost care on the part of the person who selects the coal, and of the captain. If the captain finds that coal of the more combustible kind is in his hold, it is his duty to keep the hatches open as much as possible, so that the gas generated in the coal bunkers may pass out. The opening of the hatches usually drains off the gas. South Wales coal is generally looked upon as a safe coal, and Captain Pearce said he did not regard it as necessary to keep the hatches open. The danger from an explosion has been hitherto so remote that shipbuilders have not thought it worth while to have air funnels run down into the coal bunkers. If this were done in every steamship, the captain said, there would be no such thing as an explosion of coal gas in a bunker.

So far the captain. The coroner gives the following statement of the immediate cause of the explosion: "In my opinion, the cause of the explosion is clear. One of the three 'longshoremen who went down to the lower hold to stow the loose coal near the engines before the work of breaking cargo was begun, carried a lantern. The man who had the lantern went to the third bunker, which was full of gas, and the explosion followed. An experienced engineer informs me that the dangerous nature of South Wales coal ought to be known to the English, because it has caused many calamities in the mines out of which it is taken. The English steamship owners do not like to spend money here, so they fully victual and coal the ships on the other side. This narrowness is likely to cause other explosions like this one, and perhaps of a more serious nature. No steamship should carry more coal than she needs for the voyage out, and she should re-coal here."

We are of opinion that this view of the cause of the accident is correct. It does not necessarily follow that the particular kind of coal with which the "Greece" was laden, was specially inflammable, for we are quite sure that a great variety of bituminous coals, such as are commonly employed for steaming purposes, would be liable to become dangerous, either from spontaneous combustion or by reason of the evolution of inflammable gases, or from both causes combined, when confined in the hold of a vessel for a length of time; and the rule should be legally prescribed and enforced, that no steamer engaged in the transportation of passengers should carry more coal than is sufficient for a direct trip to her destination, if coaling there is practicable. This regulation might not entirely do away with such accidents, but it would certainly materially reduce their number; and with reference to this last point, it may be added that accidents from this cause—that is, from the spontaneous ignition of coal or the explosion of coal gas, are exceedingly common. Without entering into specific details, we may note on this point that the London *Engineer* not long ago, as the result of a careful examination of the statistics relating to this subject, published a list of *one hundred and ninety-six disasters to sea-going vessels from fire* in coal bunkers, or in cargoes of bituminous coal, which had occurred between October, 1869, and December, 1875. All of these vessels were damaged, and many were destroyed; and the same journal appends to the above statement a record from Lloyd's, of 65 sailing vessels and 4 steamers, laden with coal, that were reported missing between July 1, 1873, and February 1, 1876. We might supplement these alarming facts by others of more recent occurrence, but they are amply sufficient to show that the danger we are considering is one of really serious moment, and that there is strong reason to believe that the circumstances attending the accident on the "Greece" are by no means exceptional on the passenger steamers that weekly cross the Atlantic. We may have more to add on this subject at a future time.

Celluloid.—The article on this subject in our issue of last month was improperly credited to the *Journal of the Franklin Institute.* Credit should have been given to the *American Journal of Industry*, in which the article first appeared.

Technical Schools in Philadelphia.

The recent awakening of public attention to the question of technical education, is not merely local, as the public prints show this important subject to be an absorbing theme of discussion and action. Quite recently the Board of Education in Philadelphia decided to make the course at the boys' High School more scientific and practical than heretofore—a change that can but reflect credit upon that institution, which numbers among its instructors such careful investigators as Profs. E. J. Houston and Elihu Thomson. That the change will be a useful one in our eminently practical sister city cannot be doubted.

The Industrial Art School having come under the roof and patronage of the Franklin Institute, is doing successfully a work that by rights belongs more nearly to the Academy of Fine Arts.

The various night schools teach mechanical drawing to a large number of pupils. Perhaps the Franklin Institute drawing school would have had more pupils had not the Industrial Art School opened business under the same roof, and used the same class-rooms; but as it is now, the Spring Garden Institute is fairly entitled to the lead in this line, having now nearly 350 drawing pupils, from a beginning last year of only 20. Not satisfied with this unusual success, and with the good influence exerted by its library of 8,000 volumes, its free lecture courses, etc., this institute has reached out further and taken up the subject of manual training, (for which the Washington University, at St. Louis, is also preparing on an extended scale).

Instigated by the representations of possible usefulness, long but unsuccessfully held out by Mr. Robert Grimshaw to the older and slower moving Franklin Institute, the managers of the up-town institution have prepared to teach mechanical hand-work in a systematic manner, somewhat on the plan copied by the Massachusetts Institute of Technology from the Imperial Technical School at Moscow. While the scope of these classes embraces four courses in wood-working and four in metal, it was decided to feel the public pulse by the establishment, at present, of only one of the eight laid down in the schedule. Accordingly the necessary announcements having been made, following public addresses on the desirability of such schools, more than the necessary number of applicants for instruction presented themselves; and a model vise workshop is now being fitted up, the opening of the classes having been announced for January 26th.

There will be at first five model benches, 4 × 3 feet, each with two vises, and properly lighted. The vises will be of various patterns, so as to test the different makes in competition, and each pupil will learn to work on each kind of vise. The first term of ten weeks in the thirty weeks' vise-work course, covers only chipping and filing, each week a different piece being given, as follows, and in the order named: One of dogwood, to learn the "throw" of the file; five of cast iron, one of brass, one of steel, and two of wrought iron. In this course there will be used the chipping hammer and seven chisels, one rasp and eighteen files, besides the try-square, calipers, surface plate, etc.

The Nicholson File Co., of Providence, R. I., kindly volunteered to give an extensive assortment of "increment cut" files for use in this model shop. No article will be made for sale; but some few useful pieces for use in the shop itself, as filing tables and blocks, scribers and scribing blocks. A very important feature (suggested by Mr. W. Barnet Le Van) is the idea of teaching the pupils to work "either handed." The lessons will be given "left-handed," and the practice hours devoted to both right and left handed work. The number of hours required to complete each object will be noted, as well as the weight of the material removed.

Parallel with the lessons (under the charge of Mr.

John Hall, a veteran hand of nearly forty years' experience) will run a series of lectures on the nature of the materials and tools used in the classes, and on the philosophy of the operations performed. In all cases the right way of working will be pointed out, with the reason why it is the right way; the learner will be warned of faults to be avoided, and shown what causes their commission.

Altogether the plan is a sensible and practical one. The director of the schools, the instructor in the test courses, and the managers of the institution, are well known to be enterprising and practical, and have recently proved themselves prudent and alive to popular demands.

From time to time we expect to give notes concerning the progress of this important movement.

Use and Care of the File.

[We present herewith the first of a series of four practical and useful illustrated articles bearing upon the file, which will treat of its care and use, its manufacture by the most approved processes, and the different varieties of files, with the various applications of each. Altogether it is intended that this shall be the most complete and interesting treatise on files and filing yet published.]

The file is an abrading tool, having two duties—removing material, or shaping, and smoothing surfaces already brought to dimensions. In considering the question of filing, we must bear in mind which of these duties is required at the time, and the nature of the material worked. These two elements determine the selection of the tool and the mode of using it. The action of the file in shaping is to plow out grooves in the object worked. In finishing, the operation is that of harrowing the plowed surface to a perfect level. This analogy is not perfect, because in both cases the file entirely carries away the furrows, or the ridges.

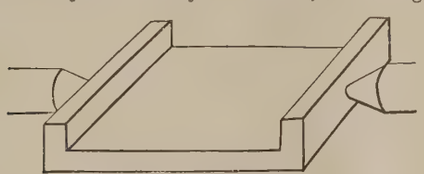


Fig. 1.—Swinging Filing Table.

Whether shaping or finishing, it is desirable that the tool work to a given line or dimension, and that its action does not extend beyond a given surface. Whether shaping or surfacing, it is desirable to produce a plane, a convex, or a concave surface. It is usual and sensible to first learn to work to a plane horizontal surface, and we will suppose ourselves to be surfacing.

The use of the file for surfacing is essentially "handiwork," as the use of guides is not only foreign to the widely varied use of the tool, but impractical, save in or two operations—as saw filing. It is desirable to learn how to move the tool, and consequently the hands which hold and apply it in a horizontal plane. As none of the natural motions of the human limbs are angular, we must attain the desired motion in a plane, by skillfully combining curved motions and by so placing the work as to best agree with the available motions. To move a file lengthwise in a horizontal direction from the body while holding it with both hands, is much more difficult than to describe a circle with a tool held in one hand. There are three hinges of the tool holder—wrist, elbow and shoulder—each a center from which swings a part of the arm. In flat filing it is usual to place the vise-top at or slightly below the elbow—hight say 42 inches from the ground for a man of average hight. This makes the plane of the work tangent to the arc described by the elbow, and brings the forearm and hand in this plane. We will suppose a piece of work placed in the vise to be filed flat. Choosing the right section and cut of file according to principles not here discussed, it must be grasped (if a large one requiring both hands) so that the handle bears against the fleshy part of the right palm, below the little finger joint; thumb lying lengthwise along the top of the handle, index finger at the side lengthwise of the handle, and the other fingertips upward. The left thumb and first two fingers should grasp the file point with the thumb lengthwise for heavy strokes, and at right angles for light ones. The strokes should be long and slow. As files are cut nearly, if not entirely, their whole length, it is poor economy to wear out the middle with short strokes, and thus waste the ends. For one-handed filing, the right forefinger lies nearly lengthwise on top of the handle.

The tendency to be avoided is to file a convex instead of a plane surface, as the file, meeting with no resistance at the front and back edges of the work, and

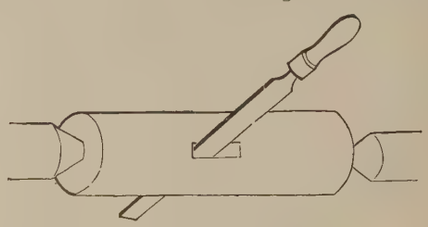


Fig. 2.

having necessarily a certain amount of downward pressure on it, is depressed at each end of the stroke. The narrower the surface in proportion to the length of the file the greater this tendency to roundness. As the file teeth (like most saw teeth) pitch forward, and cut only in one direction, (as do drills), the downward pressure should be intermitted on the return stroke, as this is apt to break or dull the points. But the file should not be given too much return clearance, as tending to destroy the "balance." It will be noted that the file, no matter what section, is generally slightly convex in linear contour. This is for two reasons; one is that in the manufacture there is great probability of warping, and thus a file perfectly parallel before hardening, would, after that process, be concave on one side, and hence incapable of working a flat or convex surface. The other reason is that this convexity better enables the filer to get at high places in the center of large flat surfaces.

It is a crucial test of good filing to produce a true flat surface on an edge one-eighth the length or stroke of the file. This imperatively requires convexity in its length, to counteract springing. Slender files should be so held as to bend them and give them more convexity. The greater the convexity the greater the bite, especially on broad glassy surfaces of such a granular material as cast iron. For finishing slide valves and seats, printing-press tables, etc., lengthwise convexity of file is absolutely necessary.

To avoid the rocking motion alluded to, the learner should mark with a center punch one or two spots in the center line lengthwise of his work, and endeavor to file them out without touching the front and back edges. There is one mode of avoiding this rocking difficulty, especially for delicate work, such as metal patterns. If the work be a thin flat piece, it may be clamped on a swinging table, or cleated board nicely hung on centers, as shown in Fig. 1. The rocking of the file is responded to by table and work, and the surface must be plane. Mortised work, as key-ways in shafts, may be similarly hung on centers, as seen in Fig. 2. To mark accurately the lines on spindles for long mortises, the nose of a lathe tool can be run along the surface, or a key-seat rule will serve the same purpose. But the swing attachment hardly comes under the head of vise work, and should be avoided by the learner.

In some branches of mathematical instrument making, the learner is taught the throw of the file on dogwood blocks rather than on a metal object; of course using wood rasps and wood files. A block $6 \times 3 \times 1$ inches makes a good filing block, and is less fatiguing than metals to work on.

For thin flat objects it is necessary to hold them on a filing table, shown in Fig. 3. The lower part of the T is held in the vise. If the table be of wood, the object is held by wide-headed tacks or nails around its edge, or by wire; if of metal, (cast iron is used), then sliding clamps or straps are employed, roughened on their lower surfaces, (except for finished work), and shifted along as the work progresses. This cast-iron block is also good for use in a drill press, where there is a great number of holes to be made and both hands are needed for the drill and the oil. It may be held in an eccentric chuck. It is also good for buff-work. It must be planed and finished, and is itself a good job of filing for a learner. For holding objects of irregular or filleted base, a wooden or cast lead "counter-part" is screwed to the block, and the object held to it by wire.

It is well, in commencing with a new file, to chalk one side and not use it, or to keep it for nice work for awhile until the other side gets worn. A file, where it is to be worked in different metals, should be used on brass, cast iron, wrought iron, and steel in the order named; and where its use is limited to one metal only, on wide surfaces before putting it on narrow ones. Oil and chalk are sometimes used for this last-named kind of work. The skin of cast iron is especially injurious to file teeth, not only on account of the chilling and hardening it gets in the mold, but by reason of the particles of sand apt to be imbedded in it, (also found in brass castings). Thin edges or corners of cast iron may be so chilled as to be harder than the file itself.

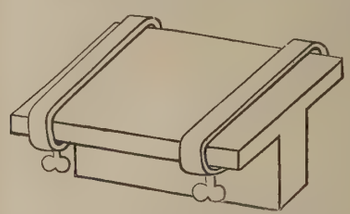


Fig. 3.—Fixed Filing Table.

The scale of cast iron objects should be removed (1) by pickling in acid, or (2) by grinding with an emery wheel or stone before touching a file to them. Pickling is best to remove scale and sand, and grinding for chilled skins. For gray iron the best pickle is one part sulphuric acid to two parts of water, kept in a leaden trough, or a wooden one well pitched. The objects may be dipped in this, or have it poured over them. They should be rattled when dry, scraped, and cleaned with old files and with stiff wire scratch-brushes, till free from scale or sand. For brass or gun-metal castings the pickle is nitric acid in five parts of water.

Black places in wrought iron forgings should also be avoided as tending to ruin the file. A three square file should never be used for filing saws, as it would be ruined and do a bad job besides. The filings, especially of wrought iron, tend to "pin" or clog the file teeth, and sometimes get so wedged in as to resist removal by occasional rapping against the bench. In this case a stiff wire file brush (Fig. 4) made of cotton card mounted on a wooden back should be used, and if they still prove obstinate, they must be scratched out with the edge of a piece of sheet brass, hammered down to a feather edge, or with a steel wire sharpened at one

Fig. 4.—Wire File Brush.

end and bent into a ring for a handle at the other. Minor clogging may be removed by wiping with the hand or on the apron. Chalking the file diminishes "pinning" by offering the small filings no good surface to cling to. The chalk should be frequently renewed. If the teeth are made by a sharp chisel, and hence an acute angle at the bottom (Fig. 5), as is unnecessary for biting purposes, pinning will be more common than if the bottoms of the ridges are made flat by a chisel with the acute edge squared off (Fig. 6). Pinning is often caused by fine filings and gummed oil. If very bad from this latter cause, the file should be warmed to soften the gum and then cleaned with a wire scraper. Chalk or charcoal rubbed on a greasy file assists in cleaning it with a brush, as they absorb the oil.

One of the very best ways to clean very dirty files is with a jet of steam at, say 40 lbs. pressure. The file should be kept free from oil, on broad smooth glassy cast iron surfaces, else it will not "bite," but burnish and harden the surface and dull its own teeth. But on the narrow edges and fibrous metal, oil should be used. Files should be kept neatly laid in a row on a bench or in a rack, when not in hand. Being delicate tools they should not be thrown down, nor used on work liable to injure them. The newer and sharper files are, the more liable they are to ruin each other by knocking about together in a drawer, on a bench. Where they are not locked up, each should have a regular place in a rack at the back of the bench. The rack is made of a strip of board with holes bored in it to admit the file, or, what is more convenient and permits the tool to be easier and more quickly withdrawn, having deep narrow notches in its front edge. Double cut files, the most usually employed, are not fit for the softer metals as copper, babbitt or lead. These require single (or float) cut and quite coarse teeth. The single cut is espcially adapted for wood as it lets the dust out easily.

There are two ways of finishing bright work; polishing and draw-filing. Polishing, once prevalent, requires the least skill and is the quicker, easier and cheaper of the two; but is more glaring and less satisfactory and tasteful than draw-filing. This latter, although it looks easy requires time, labor and skill. It consists in drawing the file back and forth over the work with both hands, sidewise, as opposed to the so-called cross-filing in which the tool is driven in direction of its length, and cuts on only one stroke. Draw-filing in which the course of teeth meets the work at a very slight angle is intended to produce thousands of minute parallel lines. The tyro makes scratchy crossing lines, the right hand tending to travel faster than the left, and hence giving the file a curved path.

Fig. 7 shows the manner of holding the tool, handle to the right. The teeth make a shearing or shaving cut. The touch tells whether any filings remain on the work to scratch and ruin its surface. The finest and final draw-filing should be done with oil.

Files may be bent by heating red hot, malleting to desired shape on a block, then re-heating high, and quenching in cold water.

Recutting files after the teeth are beyond further duty, is advocated by some. If it be employed it is well to see that they are the full thickness when bought. That marvelous invention, the *sand blast*, is extensively employed in recutting. As recut files are apt to break, it may be best to make scrapers or other tools of them; or to anneal them, hammer out the teeth, and make them into springs. Files for ivory and wood are not hardened, and may be re-sharpened with a hard metal file. Rifflers or stone workers and wood carvers are only case-hardened, hence of no use when badly dulled.

As regards file handles, some prefer poplar, some like other woods. Perhaps maple is the best. Bass is frequently used. But in all cases they should be neat and regularly, plainly but well finished and varnished, more convex than concave, so as to fit the hand; having a neat tight brass or iron ferule to prevent splitting, and without fillets. The corn cob or broom stick handle is an abomination. Each file should have its own handle, just as much as a chisel should. No one ever sees a carpenter pulling one chisel out of its handle to put another in. First, the tangs should not be burned into the handle. That is slovenly, is not a tight job at first and makes the wood brittle and apt to split.

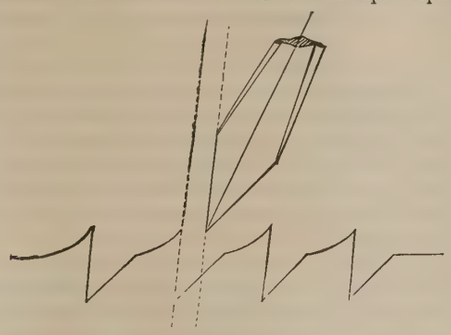


Fig. 5.—Sharp Chisel-Cuts.

The next abomination to burning the tine into the handle is binding the latter with wire after it has split.

Colossal Improvements at Rockaway.

A number of capitalists having secured property at Rockaway Beach intend to make some vast improvements which will transform that always popular resort into a watering place as desirable in all respects as Coney Island. The entire sum to be expended on the improvements is estimated at not less than $5,000,000. A new railroad is being built from Hunter's Point to the beach. It will cross Jamaica Bay from Woodhaven to Hamell's, whence a line will extend to Far Rockaway, and run down the beach as far as the Neptune House. Ten locomotives and 100 passenger cars have been contracted for, to be delivered in June next. Some of the cars are of the drawing-room pattern, and the whole equipment of the road will be excellent. It is not yet certain that the entire route will be opened by June, as some difficulties may occur on a part of the line in regard to the right of way.

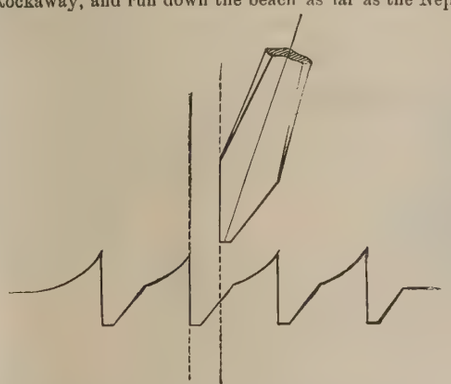


Fig. 6.—Best Cut.

The railroad company which made a contract for its work with Benjamin E. Smith, of Buffalo, is practically united with a company of western capitalists, represented by Henry Y. Attrill, who has secured one hundred and seventy-five acres of beach from De Witt C. Littlejohn for $80,000, and $200,000 have been expended in the purchase of six hundred acres adjoining, which extend to the extreme western point of the beach, opposite Coney Island. The title to this latter property is, however, at present in dispute. The beach station for the new railroad will be situated about 1,000 feet below the Neptune House, and is to be 1,500 feet long, with sufficient width to enclose four trains. Outside of it a broad, covered boulevard, laid in asphalt, will run from ocean to bay, connecting with the wharf on the bay side, and ending on the surf side with the promenade where the hotel is to be built. The hotel is to be 1,100 feet long by 400 deep, and will include four stories, of which the first will measure 18 feet between beams, the next two 14 feet each, and the fourth 12 feet. There will be a promenade on the roof, with seats for 200 persons, and a turret will surround it, in which red and blue lights will be placed. A piazza 70 feet in width will run along the front of the building. The first story of the hotel will contain the restaurant, bar room, office, sitting rooms, check-room and toilet-rooms, the second the parlors and private dining rooms of permanent guests, and the upper stories the sleeping-rooms and bath-rooms. About 1,200 permanent guests can be accommodated, and the dining-hall will seat 6,000 persons in comfort. Special care is to be taken to provide ample ventilation, and to guard against danger from fire. The sewage from the hotel will be carried in pipes to a main three miles away. The music stand to be erected near the hotel will be an oval covered building, open at the sides, containing flowers and shrubbery and supplied with refreshment tables. The main pavilion near by, between the ocean and the bay, will extend along the beach for 2,000 feet and be 70 feet in width. It will overlook the part of the beach devoted to bathing, and the bathers will pass under it, through enclosed passageways, to the 3,000 bath-houses in the rear. Other bathing-houses will be erected on the bay side for persons who prefer to bathe in still water. A road broad enough for carriages is to be constructed along the beach from the hotel for a distance of about three miles and a half. A ferry is to be established between Coney Island and the hotel, and communication either by rail or steamer will be effected with Canarsie. A Brooklyn connection may be made by extending Bruff's Elevated Railroad from East New York to Woodhaven. If Mr. Attrill succeeds in obtaining possession of the 600 acres in dispute, a park will be laid out, with a race-course and an amusement hall. Places will be reserved for cottages, for a children's playground, for a military parade ground and a rifle range, for a fish-pond, with an aquarium, and possibly for a menagerie. Hundreds of laborers are now employed in grading the land, and a saw and planing mill has been constructed to dress the lumber for the hotel. As soon as the foundations have been laid six hundred carpenters will be put to work on the building.

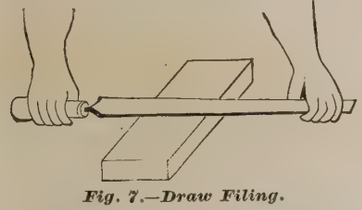


Fig. 7.—Draw Filing.

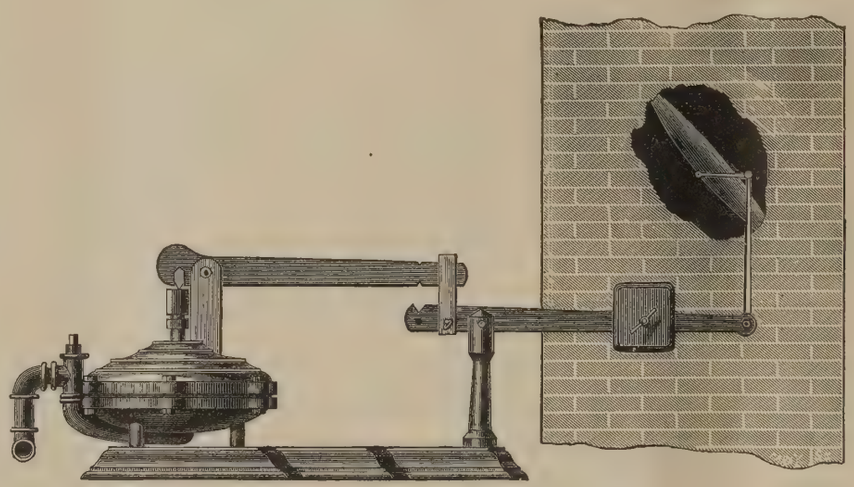
The Gregg Brick Machines.

Perhaps in no other branch of industry, during the past few years, has a greater revolution taken place than in the manufacture of brick, and it has been our pleasure on more than one occasion to speak of the highly ingenious machines to which is largely due the credit of this change. We refer to the Gregg brick machines, which have deservedly obtained a world-wide reputation by reason of the perfection of their construction, their great capacity, and the high finish and beauty of their product. These wonderful machines produce every variety of brick, including front or face, shape, cornice, ornamental, enamelled, mottled and variegated, for all kinds of outside work and inside ornamentation. The smaller size produces 10,000 bricks per day. These machines were awarded the first prize at the American Institute Exhibition in 1879, and at Paris in 1878. At the Centennial Exhibition they were the subject of much praise, expecially from foreigners, who were surprised at our progress in this line. Since than a foreign demand has sprung up for these machines, and we understand that a considerable order from Germany is now being negotiated. They are now in highly successful operation at the works of the Empire State Brick Co., at Huntington, L. I., a very complete account of which, together with the details of the extensive operations carried on there in the manufacture of brick, was published in our December number. They can at present be seen on exhibition at No. 15 Province street and 10 Chapman Place, Boston. The office of W. L. Gregg in this city is in the Boreel Building, 113, 115 and 117 Broadway.

A New Automatic Damper Regulator.

In the economical use of steam boilers, several elements are of prime importance. The combustion should be as nearly regular and perfect as possible, and the amount of fuel consumed should be properly proportioned to the amount of steam that is used. The first of these elements is controlled as fully as practicable by the proper selection of the boiler and a proper attention to its setting; the second element, however, can only be controlled by placing upon the boiler a governor of some kind that will automatically regulate the steam-making of the boiler, just as the steam engine governor controls the quantity of steam admitted to the engine. While, however, the necessity of the steam engine governor to control the steam admission is universally acknowledged, as is demonstrated by its universal employment, the no less important matter of regulating the generation of steam in proportion to the demands for it, is very frequently neglected, because it is left entirely in the hands of the fireman. We have frequently had occasion to allude to the bad consequences that follow such neglect of so important a factor in the economy of steam using. The governor of the engine must frequently make up for the shortcomings in boiler regulation. Steam is often blown off and wasted before the damper is turned, and other losses and troubles follow, with which engineers are familiar. For those, the only effective remedy is to supply the boiler with an automatic governor of its own, which will regulate the air supply and the steam generation, in accordance with requirements in each particular case. By this means a steady boiler pressure and greater economy will be assured.

We illustrate herewith an apparatus of this kind, known as the "Peerless" Automatic Damper Regulator, which is claimed by its manufacturers to fully meet the requirements of practice, and which possesses certain novelties of construction that add materially to its delicacy and effectiveness.



THE PEERLESS AUTOMATIC DAMPER REGULATOR.

To increase the amount of leverage, movement and sensitiveness of this device, the makers use a compound lever, and by employing adjustable fulcra, enable the same apparatus to be adapted to be used for either high or low pressures, as may be required, by a simple alteration of the adjustment. A siphon attachment keeps the diaphragm from contact with steam, while the diaphragm itself is perfectly supported and kept from wearing or stretching by having a rolling motion. The manufacturers claim for this appliance that "it will maintain the steam pressure within one pound; that when specially adjusted to work at a specified pressure, it fully opens or closes on two pounds variation of pressure; that it will govern high or low steam from one to one hundred pounds pressure; and that it regulates the draft to the highest possible degree of economy."

The makers are the American Steam Appliance Co., 13 and 15 Park Row, New York, who may be consulted for further details.

NOVEL USE OF THE TELEPHONE.—The pulpit of the Dartmouth College church at Hanover, N. H., has been furnished with a telephone, the wires from which run to the houses of invalid and aged members of the congregation. "The trial," it is announced, "was a perfect success. Every word spoken and the singing of the hymns were distinctly intelligible to interested auditors at over a dozen houses in town. The pastor, the Rev. Dr. Leeds, preached a very scholarly and instructive sermon, which could be distinctly heard at Norwich depot and village, two miles or more away, and across the Connecticut river." When we a short time ago suggested this use of the telephone, we did not anticipate that it would so soon be put in practice.

The Horse in Motion.

We give below a brief abstract of an interesting lecture upon this subject, lately delivered at the New York Academy of Comparative Medicine, by Prof. Manly Miles, to an audience comprising many medical men, veterinary surgeons, and others interested in the lecturer's theme, besides those connected with the Academy.

The lecturer illustrated his subject by the aid of the stereopticon, with which he exhibited a number of photographs, which, as he said, though absolutely true to life, seemed to be preposterous to those who have merely viewed the horse with the naked eye, and have no idea of the order in which he moves his legs and brings them to the ground. It is impossible, he said, for the unaided observer to follow the motions of a horse's feet. Even in walking, the four moving feet baffle the observations of the quickest eye, and when running or trotting, the changes are so rapid that it is evident that no reliable observation can be made. But science, within the past few years, has conquered this difficulty, and a number of fast trotters and runners have been photographed at full speed, both by an electrical apparatus sprung by the moving animal, and by a thread attached to the camera, and broken by the horse's foot. The perfection of the photographic arrangements for taking instantaneous views, and the imperfections of the thread attachment, were admirably shown in one instance, where the professor pointed out that when the horse passed the second camera, his tail was twisted in a very singular way—an incongruity caused by the animal's uneasiness at feeling the thread attached to the first instrument.

Among the photographs of a horse in the act of trotting, was a series of views, all taken while the animal was making a single stride. In these photographs every attitude of the horse in the course of his stride is shown, and it may arouse the incredulity of some old horsemen to be told that in every stride a horse takes in trotting there is a time when all his feet are lifted, and when he rises perceptibly in the air.

The views were admirably adapted to show this clearly. For example, in one picture the horse was represented with nothing of him on the earth except the extreme point of one of his hoofs; the next, taken the tenth part of a second or so later, showed him in the air. Lines, horizontal and perpendicular, are traced on all the pictures, marking in inches the hight and length, and it is plain that when the second photograph was taken the animal, though he had made but little forward progress, had risen some inches higher than when he had passed before the preceding camera. Twice, too, in every stride the horse stood upon a single leg, the other three being in the air. The photograph showing him balanced upon a hind leg, makes him look like the picture of the miraculous flying horse in the "Arabian Nights" a second before he soared into the air. But though the pictures are ludicrous to persons who have not been accustomed to consider the possibility of a horse taking all four legs at once off the ground while trotting, the testimony of the photographs demonstrates the fact beyond doubt.

Many of the most celebrated French and English authorities, Prof. Miles said, have argued that the hind legs of a horse are its only propelling power, while the fore legs are merely intended as supports for the body. Carefully taken photographs, however, have corrected this erroneous impression, and proved conclusively that the horse relies almost, if not quite, as much on its fore legs as its hind ones to aid it in throwing itself forward.

Pictures also of a running horse making a stride were shown, but so much dust had been thrown up by the hoofs that the views were often obscured. Some of them represented the animal in strange positions, and one would seem to indicate that the chromos of deer and other four-footed animals, given away as a sort of "make weight" with bad tea, are not wholly untrue to life. His legs are all gathered up tightly under his body, and the wretched creature, except for his starting eyes, seems to have fallen asleep in the air.

All the horses, moving either at a trot or gallop, appear to be lounging at a snail's pace. The only indications of motion in any of them are the outspread mane and tail; and these seem to be entirely out of place on the sluggish-looking animals that they adorn.

Revival of the Iron Trade.

The Secretary of the American Iron and Steel Association has just published in the *Bulletin* a review of the American iron trade in 1879, from which we glean a number of interesting facts.

The secretary refers to the year just ended as a most remarkable one in the history of the iron trade in this country. When complete statistics are received, he says, it will be found that we made more pig-iron, more bar iron, more rails, and more steel than in any previous year. The advance in prices, too, was quite without precedent; and the importations of pig-iron, old rails, and new iron and steel rails during the year were exceptionally large. But as the most noteworthy fact in connection with the history of the American iron trade for 1879, the secretary especially notes that notwithstanding all the activity that has been mentioned, the demand for pig-iron, iron and steel rails, and iron ore, was not met, and that many orders were carried over into the present year which consumers sought in vain to have filled in 1879.

We give below in tabular form the secretary's estimates of production of the several items, in comparison with the figures of the year just preceding. The figures stand for gross tons of 2,240 pounds.

ARTICLES.	*1878.* *Gross Tons.*	*1879.* *Gross Tons.*
Pig Iron and Old Iron:		
Production of pig iron	2,301,215	2,800,000
Importation of pig iron	66,503	275,000
Importation of old rails and other old iron	5,558	175,000
Total	2,373,276	3,250,000
Rails:		
Production of iron rails	288,294	450,000
Production of steel rails	499,817	650,000
Importation of iron and steel rails	9	60,000
Total	788,120	1,160,000
Iron Ores:		
Lake Superior production	1,125,231	1,350,000
Importation	31,400	300,000
Total	1,156,631	1,650,000

In the above figures no estimate is ventured of the production of rolled iron in 1879, but, excluding iron rails, (noticed in the table), the secretary estimates this item at about 20 per cent greater than that of 1878. The production of the iron mines of Lake Champlain, New Jersey and Missouri is also omitted, for want of proper data.

The secretary notes further that the year 1879 was remarkable also for the new impulse it gave to the building of railroads. The amount of new railroad built in 1879 is estimated to have been about 4,000 miles, as against 2,747 miles in 1878; 2,177 in 1877; 2,657 in 1876; and 1,758 in 1875. The mileage added in 1879 has probably only been exceeded by that of the years 1872 and 1873, in each of which years it reached approximately 7,000 miles. The increased demand for new rails, the secretary holds, was one of the leading causes of the revival of the American iron trade in 1879; but the most potent exciting cause was the sudden demand last spring on the part of existing roads for cars, rails and locomotives, to meet the requirements of increased transportation of agricultural products, and to compensate for the wear and tear of the hard times.

Noticing the large importation of iron and steel during the past year, the secretary draws the inference that the English policy of piling up iron in bad times, to be prepared for good times, is a safe policy to follow. Concerning the future, our authority is chary of prophecy. He simply ventures to say that more furnaces and mills will be running in 1880 than in 1879, and that as a consequence our production of iron and steel will be greater during the present year than in 1879. He regrets that indications point to an increased importation of iron ores during the present year in view of the immense stores of this material available at home by the exhibition of a little enterprise. As a whole, the report of the secretary makes most satisfactory reading.

Water Tube vs. Fire Tube Boilers.

Mr. Egbert P. Watson, a well-known engineer, has recently published some interesting observations which have a very suggestive bearing upon the relative degree of immunity from violent and disastrous explosions possessed by the water tube and fire tube systems of boiler construction respectively. The observations in question relate to two actual occurrences, the facts and inferences from which are sufficiently instructive to warrant reproduction in our columns.

The first case referred to by Mr. Watson, is that of an accident resulting through gross carelessness that happened to a steam boiler on the water tube system as constructed by Messrs. Babcock & Wilcox, of this city. The circumstances of the case, given below, were such as to make the test to which the boiler was put a most severe one, and the fact that the result was *not* a disastrous explosion, scores several points in favor of the water tube system.

The boiler here referred to is located in the Brooklyn Sugar Refinery, and is rated at 400 horse-power. Recently, by one of those oversights that now and then cost scores of lives under the same circumstances, the feed-water was cut off, and not noticed until the water level became so low that the boiler was nearly empty and the tubes were overheated. The result is shown in Fig. 1. One of the tubes burst, and this was the extent of the damage, which was speedily repaired at a cost of $15, and the works were running the next day.

The second case is very analogous to that just recited, but is even more instructive, as the boiler was subjected to a severer ordeal than the other. This boiler is in the Elizabeth (N. J.) jail, and was of the same kind as that in the foregoing case. It was in charge of one of the convicts, who, after starting his fire as usual in the morning, was surprised not to observe, after an hour or so of waiting, any signs of activity in his steam gauge. This fact was disclosed to some of the officials of the prison, and an investigation was instituted to ascertain the cause of such unboilerlike behavior. This investigation disclosed a fact that at once relieved the boiler from any responsibility for the absence of steam—for there was no water in it. It also showed that the blow-cock was wide open, and had been so since the night before. What followed, we give in Mr. Watson's own words:

"After the syndicate had opened the furnace door and seen the red hot tubes, it was thought a good idea to get some water in the boiler as quickly as possible; so they shut the blow-cock (for a wonder) and turned on the city water. The result justified their expectations; steam was made very quickly; for a moment it roared through the safety valve with a fearsome sound—and that is all that happened, beyond the renewal of a few of the tubes in the lower course."

What might have happened had either of these boilers been fire-tube instead of water-tube boilers, we do not pretend to say, but think Mr. Watson is not far out of the way in venturing the statement that "it is not contrary to precedent to say that, in all probability, there would have been an opportunity for a coroner's inquest and a new jail."

Fig. 1.

Another case—this time of a fire tube boiler—has been brought to our knowledge by an esteemed correspondent of this city, which is equally instructive. In this case the boiler was a new steel one, in George Campbell's woolen mill in Philadelphia, which was allowed to boil dry, as in the foregoing cases, by the oversight of the fireman. The result in this case (see Fig. 2) was that the boiler bulged 4½ inches in one place and 3 inches in another. The correspondent to whom we are indebted for the facts in this case, is decided in the opinion that the material of this boiler alone saved it from going to pieces under the circumstances narrated, with disastrous results. The owners in this case, however, did not escape so easily in pocket, for their boiler had to be removed from its setting, carried to the boiler shop, new courses put in, and reset, at a cost of several hundred dollars. Under the circumstances, however, when it is considered that a disastrous explosion in this case would in all probability have been the consequence had the material of the boiler been iron, the lesson taught was very cheap.

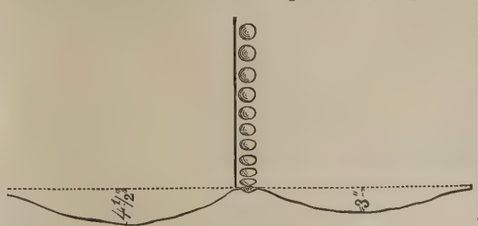


Fig. 2.

Asbestos Coverings for Steam Boilers and Pipes.

The uses to which asbestos is at present put in the arts are almost as various as the varieties and qualities of the material itself. It is only of recent years that any well directed systematic attempts have been made to utilize this mineral on the commercial scale, but in this brief space of time it has formed the subject of a great number of patents here and abroad, covering quite a surprising array of special manufactured products and of applications in the useful arts, of which not a few have considerable merit. From the articles which have appeared in this journal from time to time during the past few years, our readers will be sufficiently familiar with the general properties and peculiarities of asbestos to render repetition in this place unnecessary. Our purpose is rather to record the success which has been attained by certain asbestos products which will be of interest to our mechanical readers. We have special reference here to the application of asbestos as a heat insulating covering for steam boilers and pipes, as practiced by Mr. H. W. Johns of this city. The name of this manufacturer will be recognized by most of our readers as that of the original pioneer in this branch of industry, and from our personal familiarity with the subject we feel quite safe in making the statement that what measure of popularity many of the products of asbestos enjoy today, is due to his perseverance in sticking to the uphill work of making the market and creating the demand for a class of goods that were a few years ago entirely new. Mr. Johns' method of employing asbestos as a covering for steam pipes and boilers, consists, briefly described, of a cement mortar which is charged with asbestos in a flocculent condition (not unlike paper pulp). This cementing compound carrying the asbestos is applied directly upon the boilers or pipes. When it has set, which it speedily does, it forms a good heat insulating covering upon them.

A modification of this procedure just described, consists in applying first to the steam pipe or boiler a turn or two of a lining felt, containing asbestos as its principal constituent, upon which the cement above-named is then applied, forming a light, porous substance partaking of the nature of a felt and a cement, and therefore appropriately called "asbestos cement felting." This procedure is affirmed to have several advantages. It provides, in the first place, for the expansion and contraction of the metal, from which cause the cement coating would be liable to crack, and it also reinforces to no inconsiderable degree the heat-insulating virtues of the covering.

Another special asbestos product both novel and useful, and which is applied to the same uses as the foregoing, is the so-called "asbestos lined hair-felt," which is claimed by the manufacturers to be especially adapted to the requirements of marine and locomotive boilers. In this composite product the asbestos lining serves to protect the felt from charring. The non-conducting qualities of all these coverings is affirmed to be excellent, and we are advised that they have been largely introduced with satisfactory results.

Another and more elaborate procedure which has lately been devised by Mr. Johns is known as the asbestos air-chamber covering, which is especially intended for steam and hot air pipes and consists in first covering the pipe with a layer of asbestos lining felt (a strong sheathing to one side of which is attached a layer of asbestos), then follows a layer of hair-felt with an envelope of impervious sheathing felt covered with asbestos paint, producing an air-tight chamber filled with hair, insulated and protected from damp by contact with the heated surfaces by the lining felt employed. The number of these felt-packed air spaces can be increased as may be desired. This covering may be removed for repairs and replaced without injury.

The address of the makers of these and other asbestos products, is the H. W. Johns Manufacturing Co., 87 Maiden Lane, New York.

Wood Books.—In the museum at Hesse Cassel there is a library made from five hundred European trees. The back of each volume is formed of the bark of a tree, the sides of the perfect wood, the top of young wood, and the bottom of old. When opened, the book is found to be a box, containing the flower, seed, fruit, and leaves of the tree, either dried or imitated in wax. At the Melbourne Intercolonial Exhibition of 1866, Col. Clamp exhibited specimens converted into small boxes of book form, according to a design adopted by him at the Victorian Exhibition of 1851, and then suggested by Baron Müller. Australia alone could furnish a collection of over a thousand such books. At the Paris Exhibition of 1867, Russia showed a similar collection of wooden books, cleverly designed, showing the bark as the binding, and lettered with the popular and scientific names of the wood. Each book contained samples of the leaves and fruit of the tree and a section and shaving or veneer of the same.

Metallic Shingles for Roofing and Siding.

We illustrate and describe herewith the construction and mode of application of a metallic slate or shingle for which special advantages are claimed for covering the roofs or sides of buildings. We have had occasion to refer to this subject in earlier issues of this journal, but the increasing popularity of the device, will be a sufficient apology for a more extended reference to it in this place.

The construction of the shingle is shown in Fig. 2, and the appearance of a roof (or sides) covered with them is shown in Fig. 1. They are made of iron—either coated with metallic paint as will be hereafter described, or "calamined"—a name used to designate a new process of covering iron or other metals with a metallic coating that is claimed to be exceedingly indifferent to atmospheric influences. The shingles as will be obvious to our readers, by an inspection of the engravings are so constructed that they overlap each other, forming, when they are in position, a double fire and water proof roof, the special merits whereof we will present hereafter.

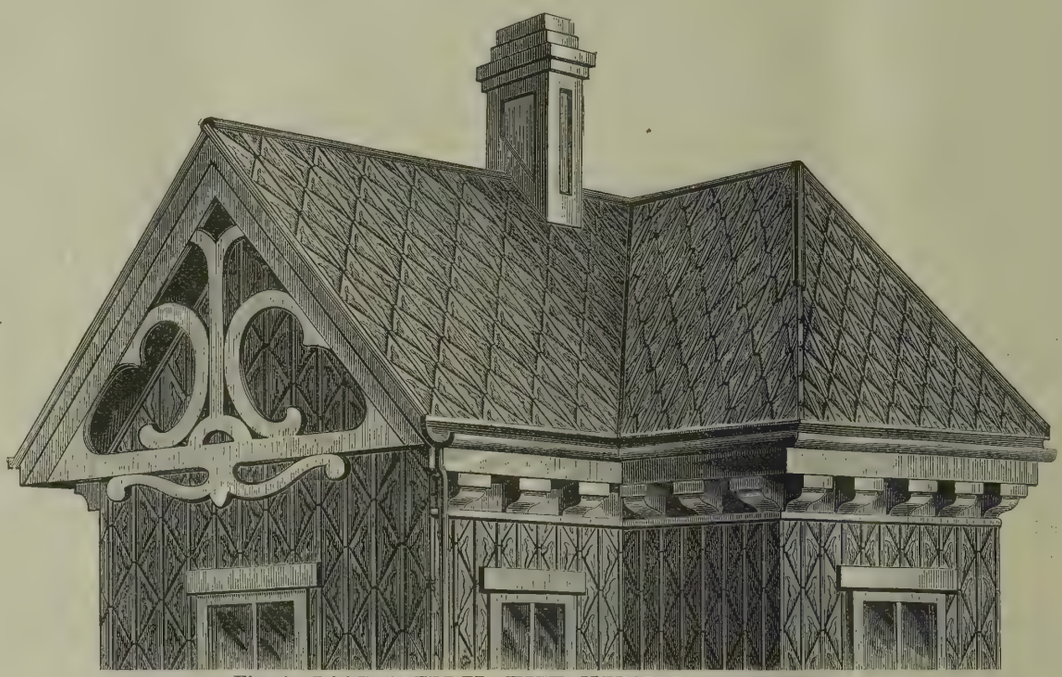


Fig. 1.—ROOF COVERED WITH METALLIC SHINGLES.

The size of each shingle is 8 7-16 by 16 inches. When laid down in place, the corrugations A A, of one course of shingles fit snugly over the corrugations B B of the course below it; the sides F F, being turned up, fit under the central rib D of the course above; and the point E, is held firmly in place by the passing under the slots H H, of the shingles in the course below. The nail holes at F F fall exactly over the upper nail holes in the course below. The result is a roof which is claimed to be strong, durable, light, storm-proof and fire-proof.

The manner of laying this roof is so simple that any carpenter can do the work with ease, the shingles requiring simply to be laid down in successive courses the same as ordinary slates or shingles. For the first or "eaves course," a course of short shingles is provided—which are simply the ordinary shingles with the points cut off, to make an even edge. The laying of successive courses then follows after the manner described, giving in effect a complete double coating of iron. For a finish, for the ridges and hips of roofs an iron ridge cap is laid down (calamined). This cap is shown in place in Fig. 1, and on the hip it is shown only part of the way down to display the manner in which the same is attached.

For the foregoing a number of advantages more or less pronounced are claimed. The points of superiority as compared, for example, with slate, are: 1. They have only one-fourth the weight of slates, and consequently permit of the employment of much lighter roof timbers. Their weight is only 130 pounds to the square (10 by 10 feet) when laid, and they may be laid on lath or slats like wood shingles in place of close sheathing. 2. They make a more completely storm-proof roof than slates; because, being of wrought iron they can be more readily adopted to the form of the roof than the former, the construction of the roof is such that it lays much tighter than slates, since the individual shingles fit singly into each other as well as overlap. They are not subject to injury either from frost or the falling thereon of heavy objects, nor to breakage in transportation or laying down as are slates, and (3) they are affirmed to be even more effectually fire-proof than slates for the reason that they will neither crack nor fly to pieces when highly heated which slates have a tendency to do, and to which they are specially liable when cold water is thrown upon them in this condition.

As compared with the ordinary tin roofs, the following advantages are claimed for the metallic shingle roof:

1. They avoid all dangers from leaks caused by expansion and contraction of the metal—as each shingle is laid and fastened independently.

2. They avoid the necessity of using solder, and on this account are more effective against the dangers from fire which will melt the readily fusible solder, and permit the sheet to warp and leave the building exposed; and

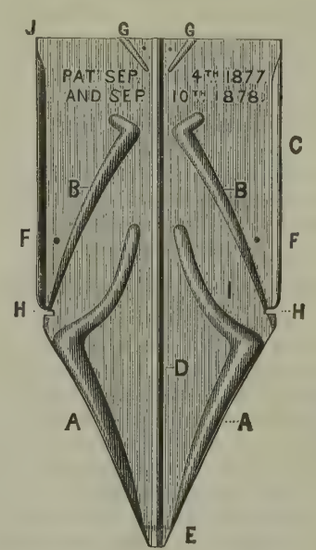


Fig. 2.—Metallic Shingle.

3. They are stronger, being made of heavier metal, and in addition to this, laid double by the overlapping. As compared with wood shingles, the following advantages are claimed: (1) They do not warp or shrink, thus giving rise to leaks, a difficulty to which shingle roofs of wood are universally subject; (2) they are fire-proof, which the shingle roofs of wood are not; and they are more durable.

There are other forms of roof covering with which a comparison need not be instituted since there are a number of the points of superiority on which stress has been laid in the foregoing that will apply with equal force to these. One point the makers of the metallic shingles especially affirm in reference to them is the fact, that as compared with any other of the modes of roofing now in vogue, theirs when once down requires less for repairs.

Before sending out, these shingles are given a coat of metallic paint, by dipping them in it while hot, a plan which is said to give better adhesion to the paint than when it is applied with the brush; and another coat is recommended for greater security against corrosion after the roof is laid; and another plan that is recommended is to give the shingles a coating of a special metallic alloy, which is effected by dipping them into a bath of the molten metal after the manner of galvanizing. This process is termed "calamining," and the coating is declared to be able to withstand prolonged exposure in any climate or situation without corrosion. When protected by this process, the shingles do not require painting, unless the color is objectionable. The durability of such shingles is affirmed to be remarkable.

From the foregoing details our readers will have obtained a fair idea of the special merits of this novel and ornamental system of the roof protection (its applicability to the sides of buildings needs no special description). The manufacturers are the Iron Clad Manufacturing Co., 22 Cliff street, New York, from whom further details may be obtained.

Advance in Wages.

The following establishments and corporations have advanced the wages of their workmen:

The Boston Nut Company, 25 per cent.

B. F. Spinney & Co., shoe factory, Norway, Me., 10 per cent.

Sager, Ashworth & Co., file works, Lowell, Mass., 10 per cent.

Pennacook and Contoocook Mills, Fisherville, N. H., 13 per cent.

The Hartford Carpet Company, of Thompsonville, Conn., 10 per cent.

The Whittenton Manufacturing Company, of Taunton, Mass., have made an advance to date from December 1st.

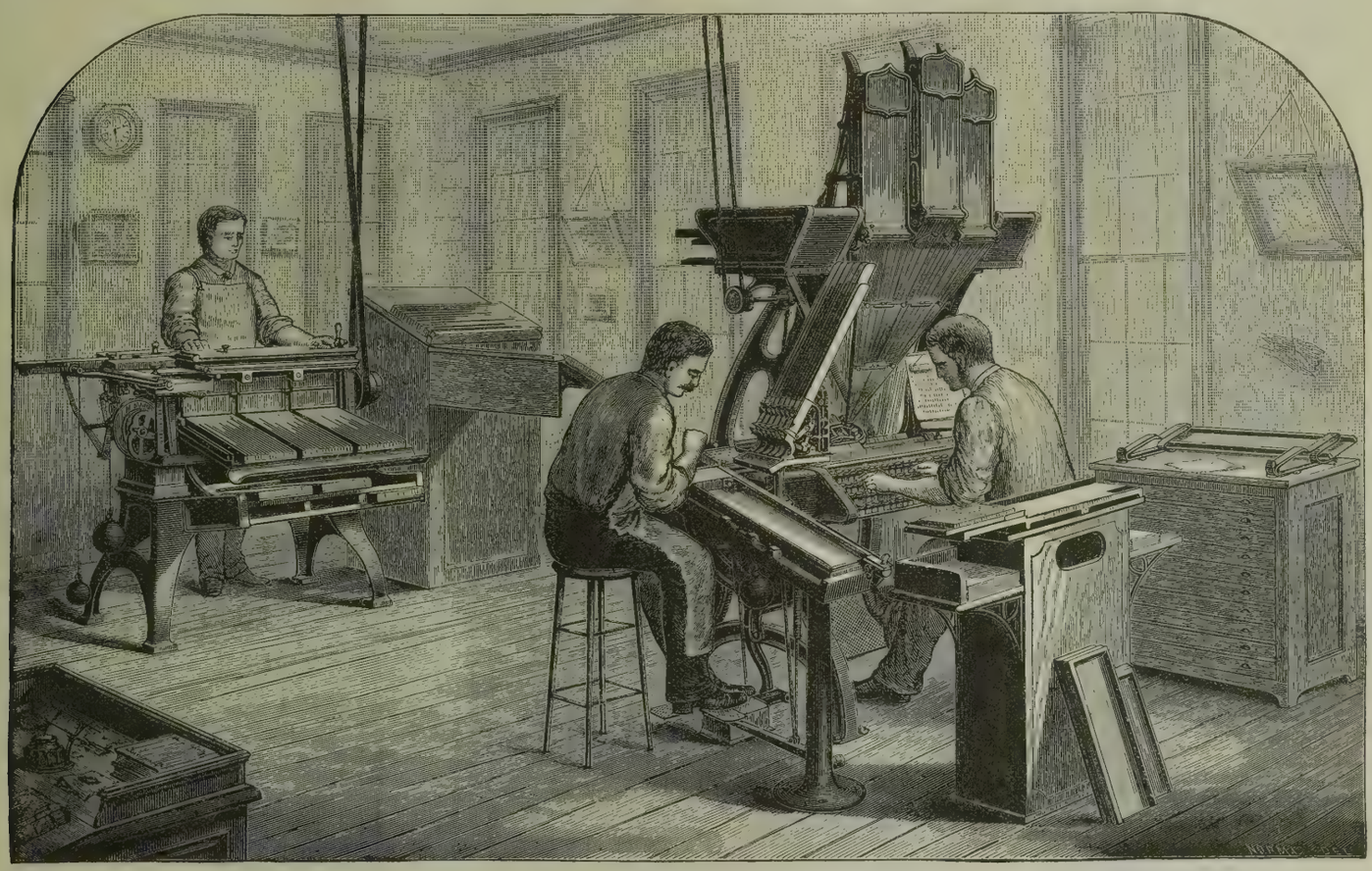
The Catasauqua Manufacturing Company have advanced the wages of their puddlers 25 cents per ton, and added 5 cents per day to the wages of the other employees.

The Philadelphia & Reading Co. have advanced the wages of its employees 5 per cent, making for the month of January an advance of 10 per cent above the wages paid in October last.

The wages of skillful molders, machinists and blacksmiths are continually tending upward.

Type-Setting and Distributing by Machinery.

We were afforded the pleasant surprise not long ago, on the occasion of a visit to the printing establishment of Mr. Henry A. Burr, at the corner of Jacob and Frankfort streets, this city, of seeing the operation of a number of type-setting and distributing machines. These were worked deftly and rapidly by skillful attendants, with a quiet attention to their business that indicated they were quite at home with the work. We were aware that many efforts and much money had been spent in the attempt to introduce type-setting machinery, and also that in England especially a certain amount of success had been attained with them; but to witness the actual operation of half a dozen machines, each doing the work of ten men with ease and certainty, was a revelation we were hardly prepared for. We are confident, too, that our readers will be as much interested in the account of these machines as we were.



TYPE-SETTING AND DISTRIBUTING MACHINES.

The accompanying illustration gives a general view of the machines at work. The type-setting machine is shown on the right of the engraving, attended by two compositors, one of whom, as rapidly as his two hands can touch the keys on the key-board before him, sends down a line of type to the second hand, who, with a "grab" set to gauge, draws line by line forward and "justifies" it from a vertical case of spaces placed before him, and places line after line in the galley as fast as the first hand sends down the type. On the left is seen the distributing machine, which distributes the type at the rate of 7,000 em's per hour, with absolute correctness, into the channels intended to receive them preparatory to being placed in position in the composing machine. This system, therefore, comprises two machines—a composing machine, requiring two skilled attendants; and a distributing machine, requiring little attention beyond "feeding" with "dead matter."

The character of the work accomplished is necessarily what is known as plain composition; but the quantity of work actually done by these machines is vastly greater than can be accomplished by hand. A fair average of hand-work is 5,000 em's per working day of ten hours, while the machine, with two skilled attendants, accomplishes the work of ten men by hand-work, or 50,000 em's. The advantage of the machine, as compared with hand work, is therefore obvious. The general features of the machines will be understood by our mechanical readers without specially entering into details of construction and operation, which, in the absence of sectional views of the important parts of the operating mechanism, would be somewhat perplexing. This is especially true of the distributing machine. It will be necessary to say, in reference to this, that its operation requires that the types should be provided with very slight nicks or cuts on the back, those of each letter being different. The machine is provided with a mechanism which moves one type after the other along a guiding plate, beneath a series of feeders, which clasp each type intended for it, and pass the same into its appropriate channel in the brass cases shown below and in front of the machine.

The Comparative Strength of Explosives.

In our issue for December, we gave the following table of the comparative energy of various modern explosives, taking dynamite as the standard of comparison:

Dualin	111
Hercules powder, No. 1	106
Dynamite, No. 1	100
Rendrock	94
Gun cotton	87
Hercules powder, No. 2	83
Dynamite, No. 2	83
Mica powder	83
Vulcan powder	82
Nitro-glycerine	81

These figures were given on what purported to be the authority of a United States Board of Army Engineers, and on the strength of such recommendation were passed as useful and authoritative by a number of our technical contemporaries, doubtless as by ourselves, without a critical examination.

A careful inspection of the table, however, must suffice to show any of our well-informed readers that it is utterly erroneous; and in view of the significant absence of any of the names of the Board of Army Engineers who are asserted to be authority for it, we are strongly inclined to suspect that the said board had about as much substantial reality about it as Mrs. Sarah Gamp's intimate friend Mrs. Harris—in other words, we "don't believe there ain't no sich person."

To return to the table, the singular contradiction presents itself, that while every one of the substances in the list, with the single exception of gun cotton, is a mixture of nitro-glycerine with some substance or substances, (the last being the pure stuff), they are all asserted to possess greater explosive energy than the pure nitro-glycerine itself. Dynamite, for example, is nitro-glycerine carried by some inert absorbent like infusorial earth; dualin is nitro-glycerine mixed with gun cotton, nitro-starch, nitro-mannite, and cellulose (wood fiber) in different proportions, according to the strength which it is intended the product shall possess; rendrock consists of nitro-glycerine mingled with fine gunpowder "to the consistency of putty and the color of mud;" and so on through the balance of the list. The query naturally presents itself, now, how the addition of explosives vastly less active, rapid and energetic than nitro-glycerine, or the addition of inert substances to nitro-glycerine, can increase its explosive force.

Nitro-glycerine is by far the most energetic of all known explosive agents, considerably surpassing in this respect even gun cotton. Prof. Mowbray tersely defines it as "the very ideal of portable force." Its explosion is instantaneous and simultaneous throughout its entire mass, in this respect being immeasurably more rapid than gunpowder; and we are gravely told in the table we are criticising that nitro-glycerine, pure and simple, is the feeblest explosive of the list. Somebody has made a mistake, or is attempting to libel the excellent reputation of the United States army engineers.

An Interesting Boiler Explosion.

The following account of the circumstances, and explanation of the recent explosion of a steam boiler, which attracted much attention, in a neighboring city, is from the pen of Mr. J. M. Allen, President of the Hartford Steam Boiler Inspection and Insurance Co., to whom we are indebted for the accompanying illustrations. The peculiarity of the circumstances surrounding this case, and Mr. Allen's extended experience, combine to make the article of special interest:

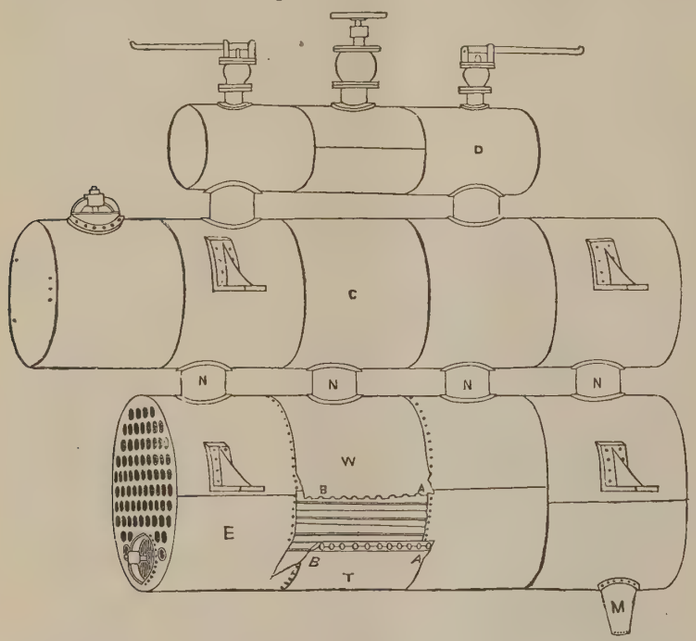


Fig. 1.

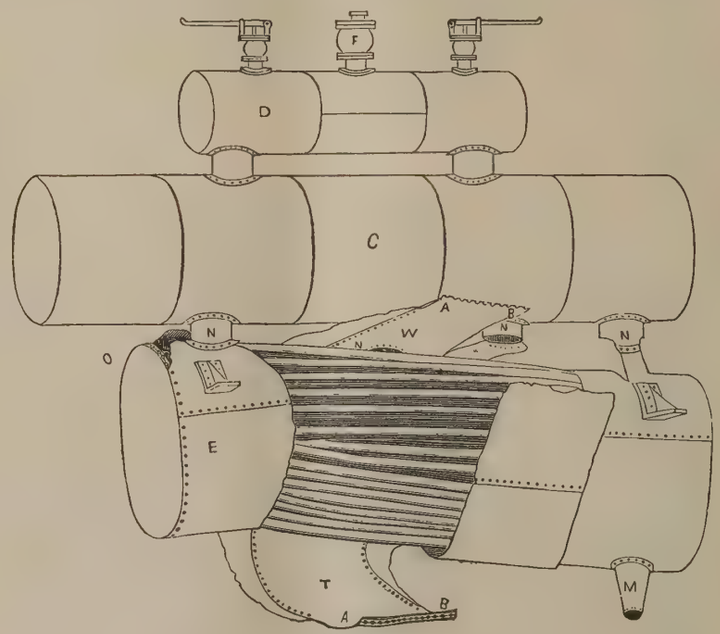


Fig. 2.

The adjoined sketches are intended to explain the phenomena attending the explosion of the steam boiler at Wilt & Son's planing mill in Philadelphia, on the 27th of June, 1879. In the details—of the buildings especially—no attempt at an accurate delineation is made, but their relative location and relation to the boiler is believed to be nearly correct.

The boiler was locally known as a "double-decker," and consisted of three cylinders placed parallel one above the other, and joined by necks of boiler iron. It is shown in its general proportions in Fig. 1, which also shows the initial rupture along the longitudinal seam A B. The principal dimensions are as follows: Lower cylinder, 12 feet long, 54 inches diameter, containing 71 (originally 73) tubes 3½ inches diameter by 12 feet long; shell of No. 00, (.38 inch) thick, marked C. H. No. 1 iron, having a tensile strength of about 54,000 pounds. The second cylinder was 14½ feet long by 42 inches diameter; it was a plain cylinder, containing no tubes or flues, and joined to the lower one by four short necks 12 inches diameter. The thickness of this iron was not taken, but it was said to be No. 2 (.284 inch) thick, of best flange iron; tensile strength not ascertained. The upper cylinder or steam drum was about 2 feet diameter and 8 feet long, upon which were placed two 2½-inch safety valves and a 5-inch steam nozzle and stop valve. A man-hole on the top of the front of the middle cylinder, Fig. 1, and one below the bank of tubes in the front head, were provided so as to admit of examination, cleaning, and repair of such portions as were not obscured by the tubes.

The water was maintained about 6 inches above the horizontal diameter of the second cylinder, as indicated by the location of the gauge cocks. When the boiler had three gauges of water it contained about 14,500 pounds of water, some 6,000 pounds of which were in the plain cylinder and its necks. The boiler was worked at about 75 pounds, and limited to 80 pounds per square inch. The furnace was below the lower cylinder at the front end, as usual, and the gases passed under it to the back and returned through the tubes, thence by a flue enclosing the four necks and a portion of each of the two lower cylinders, built just below the water-line, to the chimney in the rear.

The boiler was put in service about the beginning of the year 1870, and insured in March of that year, being fired all through the nine years almost exclusively with shavings from the planing machines. The mud drum, 2 feet in diameter and 7 feet long, connected by a 16-inch wrought iron neck to the back part of the lower cylinder, was discovered by the inspector to be getting thin from corrosion, and it was removed in May, 1872, and a conical funnel M, Figs. 1 and 2, placed over the opening, through the small end of which the boiler was fed and blown off. The steam from this boiler was used principally to drive an engine, 16-inch cylinder by 36-inch stroke, 55 revolutions per minute.

The explosion took place shortly after starting the mill on Friday morning, June 27, 1879, demolishing the two-story brick wing of the mill in which it was located, and the small wooden dwelling in which three members of the McAvoy family were killed. Its location is shown in dotted outline in the right foreground of Fig. 3. The engineer, who had probably completed the round of his morning duties, was seated in the doorway, just in front of the boiler. On the breaking of the shell of the lower cylinder on the line of the seam A B, Fig. 1, the first gush of water issued into the furnace, and, guided by the heavy furnace walls, rushed mostly to the front through the ash-pit, taking the fire-front and the unfortunate engineer across the alley into the three-story brick dwelling marked L, Fig. 3.

The remainder of the 14,500 pounds of water, now relieved of pressure, instantly expands by reason of its contained heat, and a large portion of the water is instantly converted into steam with a suddenness that gives the operation the character of an explosion. The reaction of the issuing water causes the boiler to rear at the front (see Fig. 2) and recoil against the wall of the main building, the proper direction being given to the water (which is continually expanding) by the parallel surfaces of the tubes; the lower cylinder is thus driven through the wall, while the impact of the middle cylinder against the wall arrests its motion in that direction, tears it from the lower one, and it takes an upward direction, starting first at the rear, impelled by the reaction of the water issuing from its broken

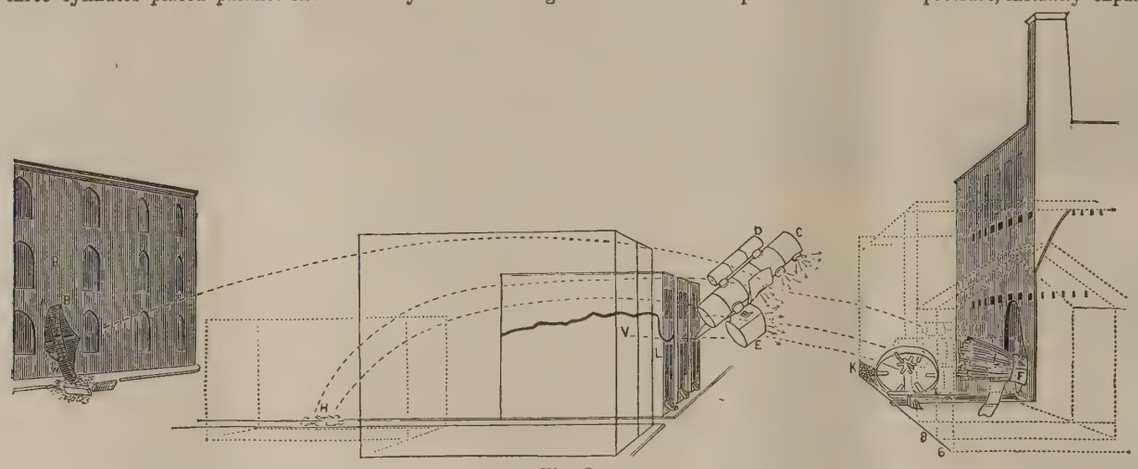


Fig. 3.

necks; the portion E, Fig. 2, having lost its direct connection with the rest of the lower cylinder by the tearing away of the complete ring of plates W T, Figs. 2 and 4. This having happened simultaneously with the flight of the fire-front and the engineer, is now, by the impact of the cylinder C against the wall of the mill, thrust from the tubes, which at once diverge, and

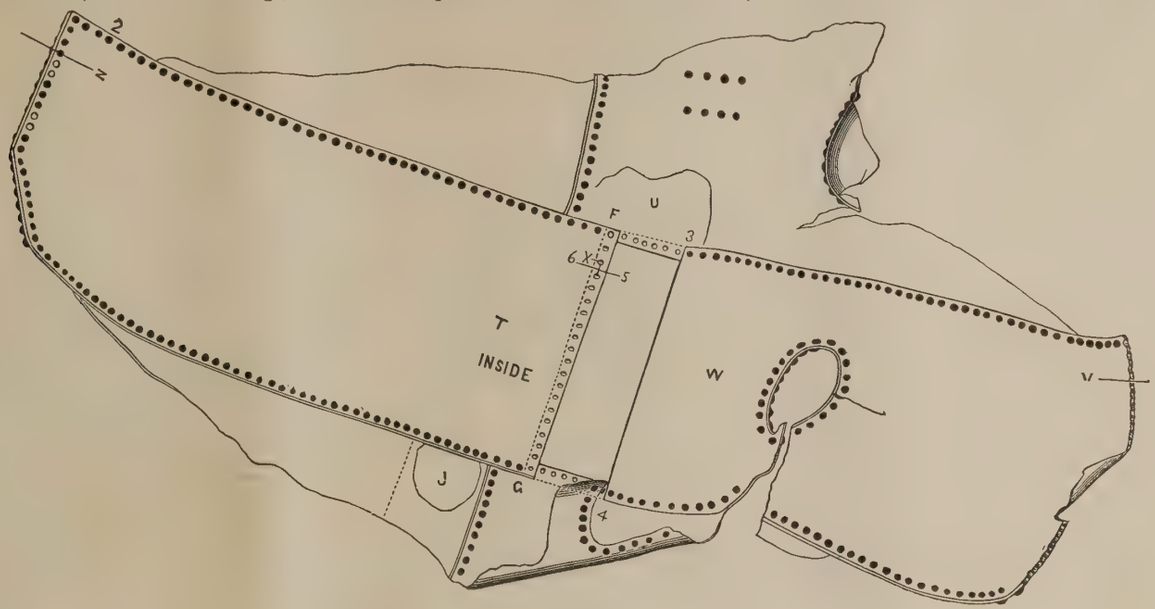


Fig. 4.

are bent and twisted, as shown in Fig. 5. The boiler is thus separated into two principal parts; the main portion, consisting of the steam drum D, middle cylinder C, the ring of plates W T, and the front head with its attachments E, the whole represented in perspective in Fig. 3, as flying toward the building L, is, on striking the building, subdivided by the shock; the portion E remains in the second story of the building at V, the cylinders C and D remain attached together, and fall upon one end of C at the point in the narrow alley marked H, and topple over toward the left foreground of the picture into the smithy of Mr. McFadden, the location of which is designated by the dotted outline in the rear of the three-story brick dwelling seen in full outline in the left foreground, while the burst ring of plates sails on toward the left into Beach street, and lands on the end of the plate W upon the curb stone, whence it rebounded against the warehouse, leaving a scar upon the brick front at R, resting at last against the wall as shown. The back corner of the dwelling marked L, which is above the irregular line, was knocked off in this operation, while the front wall at the second story was caved in by the previous manoeuvre of the cast-iron fire-front.

Fig. 4 is portion of shell blown into Beach street (see W T, Fig. 2; dotted lines mark the parts cut out for testing; U and J, location of blisters; W, old plate; T, new plate, which took the place of a blistered one when the general repair was made in January, 1879.

(*Conclusion next Month.*)

The Walled Lakes in Iowa.

Under this title there has lately been widely circulated an account, which has even found its way unchallenged and uncriticised in the columns of certain technical journals, respecting the so-called walled lake in Wright county, about 150 miles west from Dubuque city, Iowa. These accounts, which are substantially the same, repeat in its most exaggerated form the popular error that the origin of these peculiar walls, or, more properly, embankments, is to be ascribed to human agency. It may not be amiss, in view of the wide diffusion of this error, to devote a brief space to its correction.

There appear to be two of these so-called "Walled Lakes" in Iowa; one in Wright county (above alluded to), and the other in Sac county, both of which have received this peculiar designation on account of the existence upon their borders, of embankments, which are by popular tradition believed to have been the work of the ancient aboriginal inhabitants of that region, and which have given origin to fanciful stories, like the one above referred to.

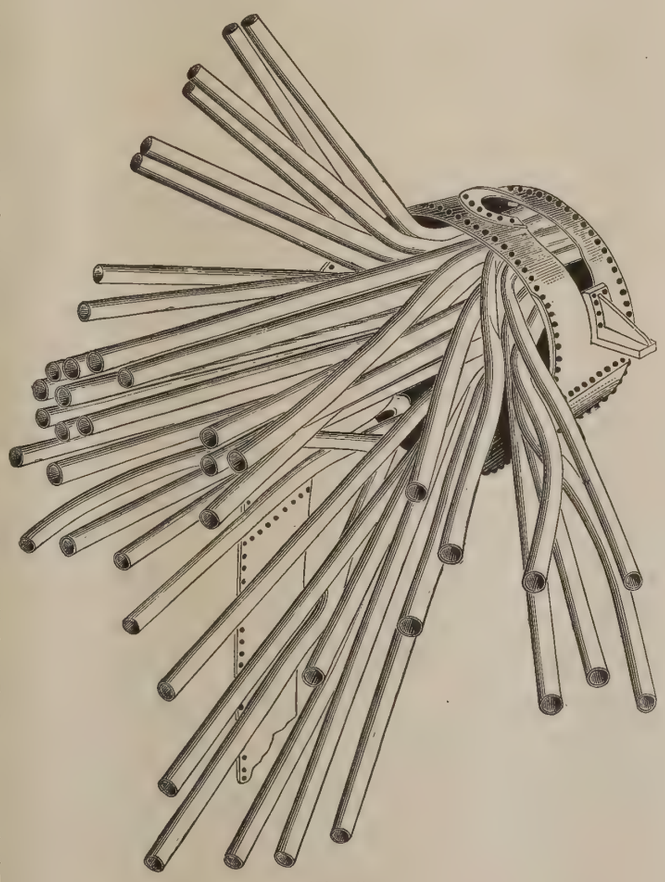


Fig. 5.

The correct explanation of the formation of these "walls," or embankments, is exceedingly simple. They are produced by the lateral expansive force of the ice formed upon the bottom of the shallow lakes, and which, exerted from year to year and from century to century, in time removes everything it meets upon the bottom beyond its reach, piling up boulders, sand, gravel, etc., in a ridge of more or less disordered arrangement along the shore, where the expansive force of the ice ceases to act.

Below the line of freezing (that is, at depths where no ground ice forms) this action is not exerted. The statement that no stone is found within 5 or 10 miles of these lakes, is quite in keeping with the balance of the story, for the soil of the surrounding country is composed of a glacial drift, made up of a heterogeneous mass of clay, sand, gravel and boulders. The latter, which make up the stones of the embankment about the lakes, are generally so covered up with the excess of fine drift material as to be only occasionally visible on the surface of the soil in the neighborhood; but by the periodical overflow of the lakes and the action of the ice, it is not difficult to comprehend how the boulders, lying at the lake bottom, should first have become exposed, and then gradually pushed up the gentle slopes of the lake bed, until they were finally landed high and dry along the shore beyond the reach of the transporting force.

Prof. White, in his admirable "Geology of Iowa," (*vide* Vol. I., pp. 74–78) devotes some space to the explanation of this interesting natural phenomenon, and points out so clearly the fallacy of the popular story of the "Walled Lakes," that it is somewhat remarkable to see so glaring an error perpetuate itself with such pertinacity. He concludes a chapter on this subject in the following words, which cover the case very fully: "The same natural force that brought the boulders down from their Northern home, also piled them in the embankments of these lakes—namely, the expansive power of ice. These embankments are really very interesting natural objects, and it is not strange that they have attracted much attention; but with a correct knowledge of natural forces, it is difficult to understand how any person could suppose that human hands had anything to do with their construction. There is certainly nothing in the arrangement of the materials that indicates such an origin, and the liveliest imagination refuses to suggest any object for which human beings could have desired them, or to point out any evidence of human intelligence in their plan and location."

Fifty thousand gross of watch crystals are sold annually in the United States, according to the *Watchmaker and Metal Worker*, which ought to be authority.

A New Plan for Storing Electricity.

Professors Houston and Thomson described and exhibited, at the last meeting of the Franklin Institute, a new system of electrical storage, which appears to be both highly ingenious and meritorious. In what follows we give an extract of their method and apparatus from their paper in the *Journal of the Franklin Institute*, and to which magazine we are indebted for the illustrations accompanying this article.

In the system of electrical storage devised by us, say the authors, the duration of action and consequent capacity for storage is independent of extent of surface and dependent on the mass of material to be acted upon. In our method we employ a saturated solution of zinc sulphate, enclosed in a suitable vessel, at the bottom of which is placed a plate of copper, to which is connected an insulated conducting wire. At or near the top of the vessel, and immersed in the solution contained therein, is placed a second copper plate, or plate of hard carbon, or metal unchanged by contact with zinc sulphate solution, and less positive than metallic zinc. This is also connected to a wire. The storage cell so constituted is then ready for charging, which is effected by the passage through the cell of a current, the direction of which is from the lower to the upper plate. The current used is that obtained from a dynamo-electric machine, and the result produced is the deposition of metallic zinc on the upper plate, and the formation of a dense solution of copper sulphate overlying the under plate. The duration of the charging action is, of course, limited only by the amount of zinc sulphate and the thickness of the lower plate. The cell, after charging, constitutes in fact a gravity cell, and continues a source of electrical current until a reconversion of all the copper sulphate into zinc sulphate has been effected, metallic copper being deposited on the lower plate, and the deposit of metallic zinc being removed from the upper. It thus may be allowed to regain its original condition. The recharging, however, may be effected at any time, either before or after the cell has become inactive. The cell may be covered or sealed to prevent evaporation; and since no addition of new material is needed, a restoration to an active condition is at any time possible.

It is not necessary to employ zinc sulphate as the material to be decomposed, since other metallic salts may serve the same end, the only other requisite being that the lower plate shall yield to the solution a metal capable of redeposition, and the solution of which is denser than the solution employed in the cell, and that the upper plate be capable of receiving a metallic deposit and of retaining its form unchanged during prolonged use.

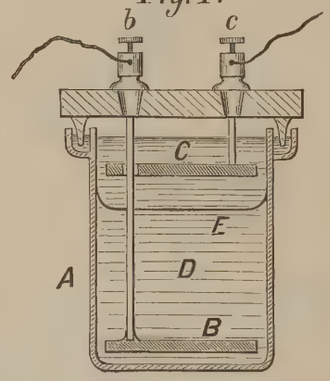
In Fig. 1, A represents a cell of glass, or other suitable material, furnished with two metallic plates, B and C, connected separately by conducting wires to binding posts *b* and *c*, the wire from the lower plate being insulated. A porous diaphragm E is placed below the upper plate C, to prevent fragments of deposited zinc from falling on the lower plate, which may occur should the charging current be too intense.

In charging, the arrangement of the cells in multiple arc or in series may be adopted, to suit the electromotive force of the dynamo-electric machine employed. The arrangement of the cells in charging may be different from that in discharging, according to the purpose for which the current is designed. Diffusive action of the solutions may be prevented by any of the well-known means used in gravity cells.

It may be objected that the economical results obtained in the storage of electricity as above described, will necessarily be low, as but a fraction of the electrical energy in charging will be expended in overcoming counter electro-motive force, or in effecting electrolysis, compared with that which overcomes the resistance of the liquid, and therefore lost in heat production. But this objection is readily met by so connecting the cells as to make their counter action or counter electro-motive force the chief resistance to its passage. Economical results necessarily follow, the economy attained being measured by the relative cost of the fuel required to drive the dynamo-electric machine and that of the zinc and chemicals used for charging a battery of equal power to that of the storage battery used.

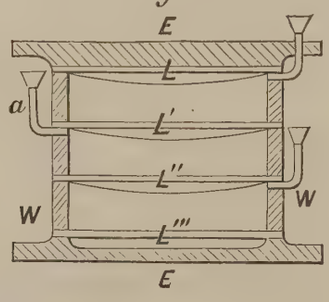
The resistance of the liquid between the plates of a storage cell may be lowered either by broadening the cell or by bringing the plates nearer together. In charging, economical results are obtained by using the plates comparatively near to each other, and separating them during discharge, and thereby avoiding loss by diffusion.

Fig. 1.



A convenient form of storage battery, designed for rapid charging and discharging, is shown in Fig. 2, where L, L′, L″, L‴ are horizontal plates of copper separated by insulating rings W W, the spaces between the plates L, L′, etc., being filled with a saturated solution of zinc sulphate. Lateral tubes *a* are provided to compensate for the expansion of the liquid due to changes of temperature, and also to provide for filling the cells. The cells are held between plates E E by bolts which pass from one to the other. In this arrangement the plates L′ and L″ serve as upper and lower plates, accumulating copper sulphate on their

Fig. 2.



upper surfaces and receiving metallic zinc on their under surfaces. The series may of course be extended.

When a number of cells are connected in series, several of them may be charging, while the remainder are used as a source of active current.

The most obvious application of a storage battery furnishing a constant and lasting current, is to replace the ordinary telegraphic batteries; the objections to the direct use of the dynamo-electric machine being mainly the necessity for continually sustaining the driving power and preventing variations or intermissions therein; to adapt the current generated to the work to be done; and to sustain a uniform electromotive force in said current. By the use of a storage battery, the dynamo-electric machine may be run at suitable intervals to produce and sustain the charge of said battery. The economy and convenience of this arrangement will, we believe, be vastly greater than with the ordinary batteries in use.

In light-houses a dynamo-electric machine can be run by suitable power at intervals during the day to furnish an unfailing and reliable source of current for lighting purposes. The purposes for which the storage batteries may be applied are so numerous that mention need not be made of them, the feasibility of each being decided by the question of its economy. In domestic economy it would be feasible to provide storage batteries to be charged by dynamo-electric machines from convenient central locations, the energy of said batteries to be used in the operation of burglar and fire alarm systems, or for light driving power.

It is practicable in good forms of dynamo-electric machines to realize in external work from 50 to 60 per cent of the power used in driving them. Of this we believe it possible to store and recover 50 per cent, or even more. Therefore 25 per cent of the original power may be given out secondarily as electrical current. If it be assumed that in the best steam engines it is possible that 20 per cent of the heat energy of the coal be utilized, then about 5 per cent of the heat energy might, we think, be recovered after storage as electrical current. Notwithstanding this small percentage, the economy would be much superior to the employment of zinc and other materials used in the ordinary battery in the production of current.

Utilization of Wastes.

The English technical journals during the past year have devoted considerable space to the topic of the utilization of blast furnace slag, to which several inventors of eminence seem to have been devoting their energies with very promising results. These comments relate specially to the procedures devised and introduced into practice by Messrs. Chas. Wood, Bashley Britten, and Frederick Ransome. Mr. Wood, whose efforts in this direction are referred to as being quite successful, converts the slag into sand as it is run from the furnace, and from this sand, mingled with a certain proportion of selenitic lime, he produces bricks and building blocks, which are asserted to possess many points of superiority over ordinary bricks, and which are gradually finding their way into use for constructive purposes. Besides this special product, Mr. Wood manufactures from slag, concrete, cement and mortar, and the peculiar product known in England as "silicate cotton," (better known with us as mineral, or slag wool). Mr. Britten's work in this direction is more interesting. He has succeeded, as we learn on the above authority, in firmly establishing the manufacture of glass (colored, of course) from this waste product, on the commercial scale; and there are now in operation, in Northamptonshire, works where the slag of the iron furnaces of that district is converted into glass bottles, which are affirmed to be superior for strength to those of common flint glass. Last, but not least, we must refer to Mr. Ransome's contribution to this interesting subject. This gentleman, whose name will be familiar to our readers as the inventor of an artificial stone which bears his name, is said to have succeeded in producing from slag a pure white cement, of greater strength than Portland cement. Mr. Ransome's procedure consists simply in taking the slag sand of Mr. Wood, reducing the same to a fine powder, with from one to two parts of chalk or limestone, and burning the mixture at a moderate heat. The product has a pure white color, which renders it preferable to Portland cement for all decorative purposes, and which is moreover asserted to be considerably stronger than Portland.

DEFECTIVE FLUES.—The defective flue is having its day. In a late London *Architect* a list of burned churches is given, in which bad flues are stated as the cause in a number of cases. One of the Harvard College buildings was considerably scorched December 15th by fire from a defective flue, and we shall expect to hear of similar cases continually through the cold season. Here should be a lesson to architects to take greater care in this important detail of building. Mr. P. B. Wight, in his address on "Fire-Proof Construction," before the New York State Association of Supervising and Adjusting Agents, said: "As a rule, the brick-work should not be diminished by the introduction of flues, but an amount equal to that displaced should be disposed on each side of a flue. By this means a buttress may be obtained. I adopted this

rule while building in Chicago after the great fire, and in one of my buildings which was burned the importance of it was demonstrated, for in this case the walls of a six-story warehouse, with brick cornice, remained intact after the whole interior had burned out."—*Sanitary Engineer.*

The Preservation of Timber.

Mr. Billin, Secretary of the Engineers' Club, read a very interesting paper at the last meeting of the society, in which he took occasion to deplore the very general ignorance and indifference on this subject displayed by American road-masters, and urged the importance of taking early and decided steps towards checking the improvident and reckless depletion of our native forests by introducing the extensive use of the methods of preserving timber for railway and other constructive uses—by methods that have been long and successfully practiced in other countries.

He instanced, as an example of the value of proper preservatives, cases in England where railway cross ties, preserved by the application of creosote, have been in service for 20 to 22 years, and that were in as good a condition apparently as when first laid down. At Portsmouth, England, he affirmed, creosoted piles that had been driven 42 years ago, were found after that long period of service, "to be as good above as below the water line, and to have outlived sixteen or seventeen sets of piles cut from the same timber, and driven in the same work, but which were not creosoted." He estimated that in this country the one item of railway cross ties alone, consumed annually the growth of six to seven millions of acres.

The same warning has been uttered time and again, but it will hardly be heeded until the actual scarcity of timber touches that more sensitive though less sentimental spot—the pocket.

Calcium Light from Water Gas.

Mr. Geo. S. Dwight, in a letter written from Sweden in regard to the Strong water gas, says he hopes that illumination by hydro-carbons will be dispensed with some day and a non-combustible substance ignited by water gas used in their place. Something similar to this was tried in Paris, we believe, where platinum cages were used to increase the volume of light. It certainly is the theoretically better way of doing the thing. But oxids of the earths really seem the only available substances, and their incandescence requires a very high temperature, such as that produced by the oxyhydrogen blow-pipe. The question then arises, whether by a regenerative system the heat of the water gas flames, very intense as it is, could not be brought up to the necessary point. A field for our inventors seems open here, especially as water gas is now being made so largely, and is soon to be made on a still greater scale.

The suggestion of Mr. Dwight is an acute one, and one that we are convinced has been buzzing in the brain of our best gas physicists for many months past. In is perfection, supposing the system to be invented and made perfect, a vast economy would be effected, for, as all gas engineers know, the hydro-carbon element of their gas is what costs money. Poor, non-luminous gas can be made cheap enough by the coal gas or water gas process. It would be a grand step toward theoretical perfection if this could be done. But we must wait and watch, as patiently as the outside world has been doing for Edison and his "wonderful lamp."

Coal Production of the United States in 1879.

The revival of general business throughout the country which began to be felt early in the past year, had a noticeable effect upon the demand for coal. So decided indeed has been the improvement that the production of coal in the United States during 1879 considerably exceeded that of any previous year in our history. Confining our attention first to anthracite, we find, on the authority of the *Engineering and Mining Journal*, that the production of 1879 was 27,825,000 gross tons, an increase of about 50 per cent over 1878, and over 20 per cent greater than the production of 1873, (22,880,921 tons), which had up to last year shown the largest amount mined in any one year. It may be of interest to note here that the total production of the anthracite region, up to the close of the last year, amounted to 427,987,832 gross tons, divided between the several regions as follows:

Wyoming region	172,944,369	gross tons.
Lehigh "	80,687,227	"
Schuylkill "	174,356,236	"
Total production	427,987,832	"

Mr. Rothwell, in his annual review of the coal trade, from which the foregoing facts have been summarized, takes occasion, in his references to the anthracite production, to denounce the present system of mining as disgracefully wasteful, and to urge upon the owners of our limited anthracite fields the necessity of improving upon it. In this connection, we reproduce for the instruction of our readers, a table prepared at our request last year for publication in Baird's *Annual Record*, and which, besides being very exhaustive, is entitled to special consideration as being by far the most accurate statements that have yet appeared touching this important subject. A careful examination of the table will serve to show how fallacious is the idea that our anthracite coal deposits are practically inexhaustible, as it has been the fashion to affirm whenever the question of their duration has been mooted. It shows, also, in the most startling manner the crudity and wastefulness of the methods in vogue for mining coal, the percentage of waste, at the best, reaching as high as 50 per cent of the amount actually marketed.

Field.	Area. Square Miles.	Area. Acres.	Average Thickness of Coal. Feet.	Quantity of Coal. Average per Acre. Tons.	Quantity of Coal. Total Quantity Tons.	Percentage of the Whole.	Amount Marketed to Dec. 31, 1877. Tons.	Amount Exhausted, Including Waste.	Amount yet Remaining.	Percentage of Whole.	Amount yet Obtainable, allowing for Waste.	Percentage of Whole.
								60 p. c. waste.			50 p. c. waste.	
Wyoming	185	118,500	19	34,580	4,097,730,000	36	151,475,872	378,689,680	3,719,040,320	36	1,859,520,160	41
								65 p. c. waste.			60 p. c. waste.	
Lehigh	43¾	28,000	20¼	36,855	1,030,120,000	9	72,422,227	206,910,302	823,209,698	8	329,283,879.2	7
								65 p. c. waste.			60 p. c. waste.	
Schuylkill	215	137,500	25	45,500	6,256,250,000	55	157,776,236	450,766,703	5,805,483,297	56	2,322,193,318.8	52
Total	443¾	284,000	22	40,084	11,384,100,000	100	381,674,335	1,036,366,685	10,347,733,315	100	4,510,997,358	100

From the above tabulation it will be perceived that the total supply of anthracite obtainable under the present wasteful system of mining, is, allowing on the production of 1878 and 1879, 50 per cent for waste, about 4,400,000,000 of tons, an amount which at the present rate of production would be entirely exhausted in 157 years; but long before this would take place, the increasing difficulties of mining would probably have put an end to the anthracite industry; while, if we assume, as we may with perfect safety, that the rate of consumption will steadily increase in the future as it has done in the past, the period at which our anthracite deposits will have become practically exhausted will be decidedly shortened. Supposing, for the sake of illustration, that the production should reach over 100,000,000 tons, which is less than the annual output of the mines of Great Britain, then the brief period of 44 years would see their complete exhaustion. Such an enormous production of this species of fuel is scarcely within the bounds of probability, for the reason that our abundant supplies of bituminous coal, which are being developed all over the country, will serve to keep the consumption of anthracite within more moderate limits. It is well, nevertheless, that the popular idea that the supply of anthracite coal is practically inexhaustible, should be distinctly understood to be a very mistaken one; and this fact being recognized, it behooves our mine owners and operators to devise and introduce such improvements in the manner of mining coal as shall reduce the present large percentage of waste to a much lower figure.

The production of bituminous coal throughout the United States in 1879, is estimated by the same authority to have been from 15 to 20 per cent greater than in 1878, and is believed to have amounted to 33,000,000 tons. This increased production is credited chiefly to the West. Adding this to the figures of anthracite production above named, we have for the total coal production of the past year over 60,000,000 tons.

The Bullion Yield of 1879.

The annual statement of Wells, Fargo & Co., just issued, shows the amount of precious metals produced in the United States and territories west of the Missouri river, including British Columbia and receipts from the west coast of Mexico, to have aggregated during the year 1879, to $75,349,501. This product was divided as follows: Gold, $32,539,920; silver, $38,623,812; lead, $4,185,769; and the total amount is less by $5,805,121 than the product of 1878. Tabulated by localities the production was distributed as shown below:

California	$18,190,973
Nevada	21,997,714
Oregon	1,037,961
Washington	85,336
Idaho	2,091,300
Montana	3,629,020
Utah	5,468,879
Colorado	14,413,515
New Mexico	622,800
Arizona	1,942,403
Dakotah	3,208,987
Mexico (west coast)	1,683,871
British Columbia	976,742
Total	$75,349,501

The decrease noticed above is chiefly credited to Nevada, which shows a falling off of over thirteen millions from the yield of 1878. For this falling off the famous Comstock lode is responsible, the yield therefrom during 1879 being only $8,830,562, as against $21,295,043 in 1878. On the other hand, the yield of Colorado shows an increase during the year 1879 of over eight millions, chiefly from the Leadville district.

The Marriage of a Scientist.—Dean Stanley was not equal to his opportunities when he performed the marriage ceremony of Professor Tyndall. The Dean should have asked the groom: "Do you take this anthropoid to be your coördinate, to love with your nerve centers, to cherish with your whole cellular tissue, until a final molecular disturbance shall resolve its organism into its primitive atoms?"

Scientific.

The Ammonia-Soda Process of Solvay.—Prof. Dewar, Chairman of the chemical section of the British Association for the Advancement of Science, lately reviewed the ammonia-soda process, with special reference to the improvements in the process introduced by Solvay, which alone have rescued the method, originally patented some twenty-five years ago by Messrs. Dyar and Hemming, from total abandonment after the repeated and costly failures of nearly a score of experimenters, and which improvements have made the method in Solvay's hands a commercially successful competitor with the time-honored process of Leblanc. The special improvements in details consist, first, in the manner of regaining the ammonia from the chloride of ammonium formed in the chief reaction. This he accomplishes by distillation with lime, and leads the ammoniacal vapors directly into a strong solution of common salt. And, second, in the manner in which the chief reaction—the decomposition of the salt—is effected. This he accomplishes by injecting into the ammoniacal brine above referred to, under a pressure of about two atmospheres, the gases of lime kilns, taking the precaution to avoid the heating of the liquid, while the absorption of carbonic acid by the ammoniacal brine is going on. These, according to Prof. Dewar, are the prime factors which have contributed to M. Solvay's success, where so many of his predecessors in the same field have signally failed.

We may notice also in this connection the suggestion that has been made to render the chlorine—which is at present practically wasted in the form of the by-product chloride of calcium—available, by substituting magnesia for lime in the operation of recovering the ammonia. The theory on which this substitution is based, is that the chloride of magnesium formed can be decomposed by simple heating (in contact with highly heated steam (?)) into hydrochloric acid and magnesia. Thus the latter can be used to decompose a fresh portion of ammonium chloride, and the former converted into other commercial compounds of chlorine, by well-known methods. The practical success of this suggestion has not yet transpired.

An interesting suggestion in relation to the ammonia-soda process has lately been made by Gerlach, which deserves mention in this connection. He proposes that this process be worked for the production of ammonium chloride, (sal ammoniac of commerce), and that the soda produced be regarded as a secondary product only. The carrying out of this suggestion would considerably modify the operation; there would be no regeneration of the ammonia, each successive operation would be conducted with fresh materials, and there would be no unutilized by-products, as is now the case.

His plan of operation is described as follows: The gas liquor, or dust from the bone black works, is simply distilled, the concentrated distillate mingled with the brine, (solution of common salt), treated with carbonic acid gas under pressure, and the precipitated carbonate of sodium removed. Thus far there is no essential departure from Solvay's method. At this point, however, Gerlach proposes to crystallize out the ammonium chloride—separating it from the residual common salt. He proposes a similar procedure for obtaining ammonium sulphate and nitrate.

These facts appear to us to have special interest to American manufacturers.

Hardened Glass.—M. de Luynes has recently communicated to the French Society of Encouragement, in the name of M. de la Bastie, further information on the progress which the industry in hardened or tempered glass has recently been making. He exhibited to the meeting numerous specimens which presented the most varied and accurate forms. There were tubes for lamps, both gas and oil, goblets of various forms, mortars and pestles, etc. As to the latter, M. de Luynes reminded the society how frequently accidents happened with them; the least fall breaking them, whereas with hardened glass they stand any amount of hard usage. He also showed capsules for pharmacy and chemistry, of all sizes and shapes, plates of glass, crystal and enamel, and coffee and tea cups in white enamel. He finished by making a striking experiment: Ordinary glasses were placed in a basket with drinking-glasses of the same shape in hardened glass; after several shakings, the ordinary glasses were all broken, while all the hardened glasses were intact. Thus it would seem that all the difficulties of the question have been solved. But what is more important, the processes of manufacture have been simplified and combined with the ordinary operations of glass-blowing, so as to considerably diminish the expense and give more regular forms and more perfect execution. Objects made with the liquid material, when they are still red, are thrown directly into the tempering bath, and are not again heated to the melting point, as at first, which often causes a change in their form. Bottles, drinking-glasses, lamp glasses, and other concave objects containing air, are received on a curved tube—a sort of siphon—which, at the moment of immersion, allows the air to escape, while the liquid enters the cavity without difficulty. All these improvements have been adopted at the glass works at Choisey-le-Roi, and it is confidently expected that in a very short time objects in hardened glass will be quite as cheap as those made in the ordinary way.

While the above item (which we take from the *Pottery Gazette*) indicates that substantial progress is being made in perfecting the details of the manufacture of tempered glass, we observe with some surprise that M. de la Bastie, through his spokesman, has made no allusion to an objection of the most serious character that has been made to these products—namely, their tendency at the most unexpected times, and without any apparent exciting cause, to disintegrate with more or less violence. Many statements sustaining this singular behavior have been published, and so far as we are aware, without contradiction. That the objection in question is a valid one, is confirmed by a recent statement made on behalf of the Siemens process for "hardened glass," in which it was asserted that the Siemens procedure entirely obviated this difficulty.

Signalling by Illuminated Steam.—When a strong ray of light is thrown upon a jet of steam issuing forth into darkness, the steam becomes brilliantly illuminated, and the light thus transmitted is visible from long distances. A familiar example of this is occasionally to be seen in the steam issuing from a locomotive engine at night, and on which the rays of light from the furnace are sometimes thrown when the driver opens his fire-door. Taking advantage of this principle, M. Carl Otto Ramstedt, late of the Russian navy, has, as we learn from the London *Times*, devised an ingenious system of night signalling on board ship, with which some experiments have recently been made by the Trinity Board. The apparatus consists of a dished chamber, in which the inventor burns strontium, or other substances, so as to produce a variety of colors if desired. At the back of the chamber is a reflector, by means of which the light is thrown on the steam, either steadily or in flashes, at will. The steam thus becomes a luminous mass, varying in color with the substances used in combustion. In practice, the light is thrown upon the steam issuing from the funnel of a steamer, and optical signals are made according to any known code of signalling, such as by combinations of flashes of longer or shorter duration. This is effected by the light apparatus being closed in at the front by a hinged cover, which is manipulated by the signaller according to arrangement. M. Ramstedt, in the first place, submitted his invention to Prof. Tyndall, who, being much struck with it, introduced it to the Trinity Brethren. They immediately arranged to have the invention tested on board their yacht, the *Galatea*. To this end they appointed a committee to be present and report to the corporation upon the merits of the invention. The result of the experiments recently made showed it to be very effective and applicable to its intended purposes, and there appears to be little doubt that it will be of value as a means of signalling at sea. The advantages of the invention are not limited to steamers, as it is equally applicable to sailing vessels, in which the light might be thrown upon the sails. Its adoption and careful working, therefore, would doubtless tend to reduce the number of accidents which are constantly occurring from collisions in our crowded channels and rivers.

Years ago the illumination of steam from the exhaust pipes of steam engines at Pittsburgh, by the flames of the bituminous coal used in the furnaces, which issue from the chimney tops, suggested to us the possibility of signalling by it to long distances. The light reflected from a steam cloud is very vivid, and may be seen many miles away.—*Scientific News.*

Artificial Production of Diamonds.—The daily papers of late have widely published the announcement that Mr. James Mactear, of St. Rollox Chemical Works, Glasgow, had made a statement to the Glasgow Philosophical Society, representing that he had succeeded, after thirteen years of investigation, in producing the diamond by artificial means. The accounts further declared that the results had been submitted to Professor Tyndall and Mr. Maskelyne, of the British Museum, by whom they were pronounced to be unquestionably diamonds. These announcements are doubtless premature; they are certainly so respecting Mr. Maskelyne, who has since publicly stated his belief that the crystals submitted to him were not diamonds, but probably crystals of a silicate. As to Professor Tyndall's reported confirmation of the identity of these crystals with the diamond, we have carefully looked over the accounts of the circumstance as published in several of the leading English technical journals, and fail to find any statement purporting to come from him. The simple fact is named, in relation to these gentlemen, that Mr. Mactear had submitted samples of what he affirmed to be diamond crystals to them for examination. Our purpose in writing the above is simply to protest against the hasty conclusions, on scientific subjects, which the newspapers are prone to accept and circulate without due reflection, and before they are verified by competent authority. There is nothing inherently impossible in what Mr. Mactear asserts he has succeeded in accomplishing, although many experimenters have essayed the same problem and failed. We prefer, however, to wait before accepting this piece of newspaper science, until we hear definitely from Tyndall or Maskelyne. The latter has already spoken, as above stated, and adversely; though, in justice to Mr. Mactear, we must add that he affirms Mr. Maskelyne to be wrong, and asks a temporary suspension of judgment.

Since writing the above, the news has transpired that Mr. Mactear has been convinced that he was mistaken in his conclusions, and has publicly admitted his error.

Vibration of Fluid Columns.—The fact that a column of air can be set in longitudinal vibration has suggested to Kundt the possibility of producing similar longitudinal vibrations in columns of water. To this end he sets the tube containing the water in vibration, and finds that the success of his experiment depends principally upon removing from the liquid all traces of gas, whether or not the latter be absorbed in the shape of minute bubbles. The gases absorbed by the liquid are partially driven out by the vibrations, and appear as disturbing bubbles. The so-called tone figures of Kundt can be shown in the vibrating columns of liquid as well as of those in air, and can be used to determine the velocity of sound in the liquid. It is found that the thickness of the glass tube has an influence on the velocity of sound—the thicker the tube the more rapid being the propagation of the sound wave.

Experiments on the Transmission of Sound.—Interesting experiments have been made by M. Abbot, intended to determine the velocity of transmission of earth waves caused by explosions, in order to settle certain questions raised by Mallet. He concludes:

1st. That a high magnifying power of telescope is essential in seismometeric observations. 2d. The more violent the initial shock, the higher is the velocity of transmission. 3d. This velocity diminishes as the general wave advances. 4th. The movements of the earth's crust are complex, consisting of many short waves, first increasing and then decreasing in amplitude; and with a detonating explosive, the interval between the first wave and the maximum wave at any station is shorter than with a slow-burning explosive. The seismometer used was a dish of mercury, the surface of which was watched through a telescope, by which the beginning and duration of the tremor could be determined. The velocity observed was, for short distances, 8,500 feet, and for long distances, 5,300 feet per second.

Microscopic Tests.—Mr. B. G. West has succeeded in tracing on glass the curves called after Lissajou. He has traced these in lines of 55,000 to the inch, and finds that they are much better for testing the power of a microscope than straight lines.

Aside from their great beauty, and the necessity of skillful illumination to see them well, the intersection of some lines and the gradual approximation of others, arising from the variation in the figures, where every degree of the sharpness of a curve is obtainable, from a line returning almost upon itself at an exceedingly acute angle, to curves so flat as to present in parts virtually the appearance of parallel straight lines—all this, combined with a knowledge up to a certain point of the nature of all lines cut in glass, makes these rulings more instructive perhaps than the markings on diatom valves, in regard to which there is as much question.

A curious feature of some of these figures is, that though all the lines would seem to be in the same plane, it sometimes happens that an alteration of focus is requisite to bring out the transverse lines. The same fact has been noticed in observing the transverse markings of the diatomaceæ.

Executing Criminals by Electricity.—The adoption of electricity as a mode of capital punishment has, says *Iron*, enthusiastic advocates in Germany, as well as in France, as witness the following imposing description of a method proposed by a German writer: "In a dark room, draped with black, and which is lighted only by a single torch—the chamber of execution—there shall stand an iron image of Justice with her scales and sword. Stern Justice is popularly supposed to have no bowels, but this German goddess will carry a powerful electric battery in her inside; and this battery will be connected with an arm-chair—the seat of death. In front of the chair shall stand the judge's tribunal, and only the judge, jury and other officers shall be present with the criminal during the ceremony of the execution. This will consist in the judge reading the story of the crime committed by the prisoner, who will be rigidly manacled to the aforesaid arm-chair, and when this is done, the judge will break his rod of office and toss it into one of the scale-pans of Justice, at the same time extinguishing the solitary torch. The descent of the pan will complete the electric circuit, and shock the victim into the next world."

Refinement of Scientific Warfare.—The refinement of scientific warfare is illustrated by the firing exercises of the French army. As the method is described in the *Avenir Militaire*, field firing cannot be carried on in the manner prescribed by the regulations without the employment of some six different instruments. Thus, an anemometer is used to measure the force and velocity of the wind, in order that the necessary corrections may be made. The pressure of the atmosphere is ascertained by a barometer, because, the sights having been graduated for use with the barometer at a certain hight, if the pressure varies, a second series of corrections must be made. A hygrometer is required to measure the amount of moisture in the atmosphere, the degree of dampness in the latter materially affecting the resistance it offers to the flight of a projectile, and consequently a third series of corrections must be made. When the fire is directed upon objects hidden from view, a plane table, called a planchette, is employed. A telemeter, or range-finder, is employed to ascertain the distance of the objects fired at. And, finally, a thermometer is used to find the temperature, sights adjusted for use in hot weather being too low for firing in cold weather.

Shoemakers' Wax to Illustrate the Flow of Solids.—Our foreign exchanges notice the following curious experiment: Last year Sir William Thomson commenced a new and curious experiment on shoemakers' wax as a viscous material. A large circular cake of it, about 18 inches across and 3 inches thick, was made; this was put into a shallow cylindrical glass vessel, which was filled with water to keep the temperature from varying with any great degree of rapidity. Below the cake a number of corks were put, and on the top there were placed some lead bullets. The result has been that, in a year, the corks have floated up through the wax, and are coming out at the top; the bullets have sunk down through the wax, and have come out at the bottom; and this, it is to be observed, has gone on while the wax was at all times in such a condition as to be excessively brittle to any force suddenly applied, such as a blow from a hammer, or such as would be occasioned were the cake of wax to be allowed to fall on a stone floor. Mr. J. T. Bottomley has been also experimenting with the same material, and has constructed miniature glaciers in wooden channels, which present all the phenomena of flow seen in real glaciers.

A Magnet Capable of Lifting Three Tons.—Mr. C. Belly, of Indianapolis, has lately made an 800-pound electro-magnet. The two iron cores are 4 inches thick by 30 inches long, and slide along a yoke 18 inches in length, so as to vary the distance of the poles. The two coils around the two cores consist of eight layers of isolated No. 6 copper wire, and the terminals are so arranged that the electric current may be sent in various ways. Pole extension for diamagnetism is provided, and the various experiments for which it is adapted are almost numberless. This magnet was made for Prof. Jahn, of one of the schools in Indianapolis.

The Sulpho-Carbonates which of late have been hopefully looked upon as an effectual remedy for phylloxera, are affirmed to have proved a failure in France, where they have been tried on a large scale.

Electricity as an Anti-Incrustator.

The following is from a pamphlet published by the late editor of this journal in 1867, at a time when several electrical devices were patented for the purpose of preventing scaly deposits in steam boilers. The excitement in regard to them at that time ran very high, and upon the report that the Pennsylvania Railroad Company had contracted for 400 electric anti-incrustators for 400 of their locomotives, speculation in the stock of Porter's American Anti-Incrustator Company was very active, so much so, that one party, whom we will not name, and who had before ruined himself in business, made $80,000 by speculating in this stock. It is not strange, then, that many were impressed with the belief that there was something in it.

Prof. Van der Weyde was urged to experiment and ascertain professionally what there was in it, and the results were given by him in the pamphlet referred to, published under the title of "Remarks on the Use of Electricity for Removing Scale from Steam Boilers, and Preventing its Formation, on True Scientific and Practical Principles." The pamphlet begins as follows:

"Observing the mysterious and powerful effects produced by electricity, it is not surprising to find persons who ascribe almost everything they cannot explain, to this agent. Thus, unaccountable steam boiler explosions were explained by 'electricity,' and attempts were made to discharge this supposed 'exploding electricity' from the boiler. Others supposed that electric currents would prevent explosions, and confounding electricity with magnetism, made all kinds of absurd experiments, as for instance, Perry, of Philadelphia, whose application for a patent, made May 2, 1864, was rejected by reason of its absurdity. However, he obtained a patent October 31, 1865, in which he claims: 'Suspending within a steam boiler one or more permanent magnets for inducing an electric current.' Magnetism and electricity are not identical—they are only related to one another, but in a much lesser and different degree than light and heat; and this claim of Perry is as absurd as it would be to suspend a kettle of hot water in a room in order to illuminate it. A second claim added to this patent describes a hollow box, with isolated lining, through which a conducting rod projects—evidently destined to give escape to the *explosive electricity!*

"Others, observing how electricity can shock a man, and that a small battery can put his muscles in continual vibration, conceived the idea of connecting the steam boiler with a powerful galvanic battery, in order to put it 'in vibration, and shake scales or incrustation loose from it,' as if a steam boiler had muscles or nerves, and could possibly be shocked by electric currents. All those familiar with the subject, know that such a large mass of metal as a steam boiler consists of, will conduct the strongest electric currents we possibly can produce, silently and imperceptibly.

"Porter, of Philadelphia, had also (October, 1865) a patent granted, in which he used a similar isolating arrangement, and an isolated point projecting out of the boiler—evidently, again, a discharge of the explosive electricity. But he adds a long spiral wire, such as that which, when wound around a wrought iron bar, charges it with magnetism by means of a galvanic battery, only the iron bar and battery are omitted, and the inside of the spiral is empty. This spiral wire, now entirely useless, is at one end connected with the boiler, and at the other isolated end is attached a disk, with a few small points. It is evident from this whole arrangement that the experiments and attempts were made, as it were, blindly—in ignorance of the principle to be applied, and not clear in regard to the results to be arrived at.

"The apparatus was placed inside some steam boilers, in the hope of getting rid of that dangerous 'explosive electricity'—that cause of so many disasters—and, it said, that some unexpected results were obtained, namely, it was asserted that these boilers remained free from incrustation, and that even scales already formed were loosened. Now, this may be true in a few instances, and prove nothing for the arrangement, as all practical engineers know how capricious steam boilers are in this respect; how some will form scale, and others, under perfectly similar circumstances, and using the same kind of water, will not; how even the same boiler one season will be covered with incrustation, and another season will not form any scale whatever—perhaps produced by the difference in the water at different seasons, or by causes that we cannot always trace. Then, it is very easy to place in steam boilers some chemical substances, for instance, sal ammoniac and gum catechu, the presence of which will protect any boiler from incrustation for about three months. But, whatever may have been the cause, to the Porter arrangement a certain credit was given as an anti-incrustator. Some enterprising gentlemen got hold of the patent, resolved to form a company, and put the apparatus in the market.

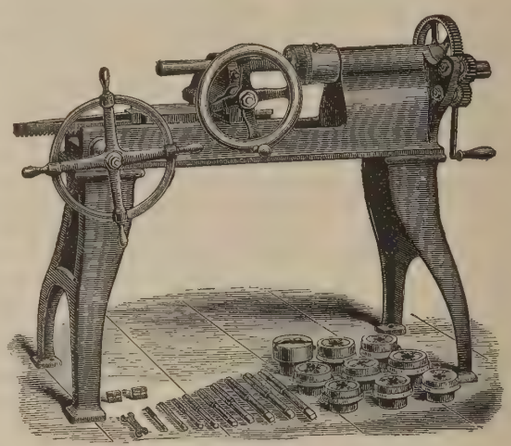
"The first thing then to be done, was to obtain the confidence of the public by means of a reasonable explanation, accounting for the operation of the arrangement. It was at first called 'Porter's Steam Battery.' John C. Cresson, of Philadelphia, was called upon to study the operations of the machine, and give a reasonable, scientific explanation, which he did in a letter, published in some of the circulars of the company."

This letter, with the balance of the pamphlet, will be given in our next issue.

Pratt & Whitney's No. 2 1/2 Hand Bolt Cutter.

This compact portable machine is designed especially for the use of ship-smiths, iron bridge builders, repair shops in mining regions, etc. Its essential peculiarity is that while in the No. 2 hand-cutter and the Nos. 3 and 4 power-cutters, the work revolves, by which arrangement the size that may be taken in is limited, the one here illustrated is so designed that the work is held firmly, and the die revolves around it, thus enabling odd sizes and shapes—as, for instance, hasp and clamp bolts for carriages—to be worked. Another feature is the gearing, seen at the right, by which the crank is used directly on the spindle of the machine for bolts ⅞ of an inch or smaller, while for the larger sizes, from ⅞ of an inch up to 1½ inches, requiring more power, the crank is applied to the stud of a small gear at the side, giving slower speed, but greater power. The machine takes, in diameter, from ½-inch to 1½-bolts and from ⅛-inch to 2-inch pipe, in length up to 18 inches; its weight is 350 pounds, including tap-chuck and 9 dies and taps.

Concerning the dies, it may be stated that necessarily this is not, like Nos. 2, 3 and 4, a "turret" or "monitor" machine, in which there are seven dies held in a revolvable cylinder, with a stop spring, and either die presented to the bolt at will. But the dies are of the same well-known adjustable type, (Grant's patent), in which there are four chasers inserted radially in an iron collet, which last is so encircled by a bevelled wrought-iron ring, having adjusting screws, that the dies may be forced inward, thus giving an adjustment of one-32d of an inch in size. The chasers, which, when dull, may be readily taken out and ground on an ordinary grindstone or emery wheel, do not *jam* up a thread, as many dies do, but cut the metal away cleanly and shapely, and leave the thread standard in shape and size.



No. 2½ Hand Bolt Cutter.

Edison's Electric Light.

The latest news from Menlo Park is by no means so gratifying as the inventor's friends could wish, or as the public have a right to expect, after the grand hurrah of the newspaper correspondents. There is trouble with the globes, and from other causes more or less serious, which the "wizard" is reported to be setting about to invent something to remedy forthwith. We have published without comment the description of this latest invention of Mr. Edison, as a simple piece of current scientific news, in which our readers would be interested; but from the first outburst of enthusiastic gratulation from newspaper correspondents, great and small, to the present diminuendo of the same, we have been doubtful as to whether Mr. Edison had really succeeded in solving the problem of cheap electric lighting.

The latest gossip *apropos* of this topic, is the publication in the *Sanitary Engineer* of an editorial, affirming that there is nothing of novelty in Mr. Edison's invention. According to that journal, the carbon filament enclosed in an exhausted globe is anticipated by the invention of one Starr, an American who took out an English patent (No. 10,919, dated November 4, 1845) through his agent King, which contained, with other matters, a description of a method of using metallic conductors of platinum, or of *continuous carbons*, heated to whiteness by the electric current. This rod of carbon he placed in a glass vessel in which he had previously established a vacuum. These facts, our authority holds, would invalidate any claims of Mr. Edison to originality in respect to his lamp.

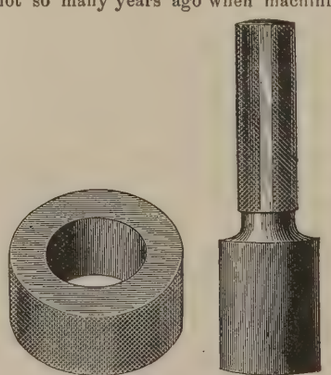
In his method of distributing and regulating the current, the same journal claims that he is quite as completely anticipated, referring for proof of the assertion to published descriptions now twenty years old. The communication referred to, to substantiate this assertion, purports to have been presented to the French Academy on March 1, 1858, by M. Jobart. We do not refer to it specially, for the reason, that though it claims to have accomplished everything that Mr. Edison now claims he has done, it does not enter into an account of the manner of doing it.

Not content with this, the *Sanitary Engineer* even affirms that the "so-called Edison electric generator is in every essential feature a duplicate of the well-known Siemens dynamo-electric machine, and would in all probability be controlled by the American patents of Mr. Siemens."

Without entering into the question of the originality or validity of Mr. Edison's patents, with which we are here not interested, we may say that thus far Mr. Edison has not yet succeeded in proving two things which are absolutely essential to the success of his system of lighting; the first relates to the permanency of his globes, and consequently that of the carbon filament; and the second relates to the equally important question of economy. On the first point the ubiquitous newspaper man reports "bad news from Menlo Park—several of the globes broken—unequal expansion of glass and platinum," etc.; while on the second, the details concerning the amount of power consumed in dividing and sub-dividing the current, and concerning the equally important point of the cost of the distribution of the system, have not yet appeared. From all of which, it would seem, that the newspaper proclamations that the vexatious problem of electric lighting had been solved, were a trifle too hasty.

External and Internal Gauges.

It is not so many years ago when machinists were content to work to "scant sixty-fourths" and "full thirty-seconds" of an inch, and indeed there are some spectacled hands in almost every large shop who remember when they used to receive instructions to take off "*about* a sixteenth." Not so long ago the rifle factories in New England were pointed out as working with unnecessary refinement, yea, even to the five-hundredths of an inch—an imaginary term spoken of with awe, and not with familiarity. In those days no two bearings of a line of shafting were exactly the same; no 2½-inch shaft could even be turned end for end with the certainty of running cold, or even entering the new bearing; no two workmen, side by side at the same bench, called an inch the same thing, or at least they made their inches different.



External and Internal Gauges.

But the peculiarly American demand and necessity for interchangeable parts—our system of duplication and working to jigs, templates and gauges, which enabled us to gain a market for our manufactures, created a demand for standards, and delicate standards at that. The rifle, the sewing machine, and the reaper had to be worked to close and absolute measurements, and the difficulties of producing these were so nearly insuperable that certain establishments grew up having as a specialty the manufacture of gauges and standards with expensive special machinery and the most skillful and experienced labor. The demand and the supply retroacted; the measurements demanded and made became more and more accurate, and gauges of more and more surprising accuracy came first into the market, and then into the shops, until thousandths of an inch are recognized by all ordinary machinists as appreciable and easily measurable quantities, and ten-thousandths are familiarly spoken of, even where there is no necessity for their use.

Such internal and external gauges as are shown in the accompanying cuts, and which are manufactured by the Pratt & Whitney Co., of Hartford, Conn., are accurate to say the one-20,000th on a half inch size. They are made of hardened steel, in order that their size may not change by the friction of use; although they are used merely as office standards by which to compare and correct those in daily use at the bench.

The bore of the collet or female gauge tends to assume an hour-glass section (that is, contracted in the middle of its length) during the process of hardening, and must be afterwards carefully lapped out to perfect parallelism and accurate diameter. The two are made so as to fit so exactly that the heat of the hand on the plug will prevent its entering the collet; and, once entered, the parts must be kept constantly moving else the plug will have to be driven out by a piece of hard wood and no trifling blows of a mallet.

There is a pair of screw-thread gauges having a similar purpose—the female being delicately adjustable by a very ingenious device. The gauge proper is held in a ring, and has in its circumference six splits or kerfs, and a taper screw in one of them (parallel to the axis of the thread) enlarges this screw ring or permits it to contract. Thus, instead of assuming a horseshoe shape, as would be the case if had but one split, the slight distortion is divided into six and distributed over the whole circumference.

Still Another Letter-Copying Process.

Herr Adler has communicated to the Vienna Photographic Society a multiplying process based upon the use of the glue plate, consisting of gelatine, glycerine and water (though the last mentioned ingredient is present in a smaller quantity than usual), used in the hektograph and other similar processes. For writing or drawing Herr Adler uses a concentrated solution of alum, to which, in order to render the writing or drawing visible upon the paper, a few drops of some aniline color is added. Before laying the writing or drawing upon the gelatine surface he passes a damp sponge over the latter to allow the moisture to sink in for a few minutes, so as to have a greater effect upon the alum; then he lays the written side downward upon the gelatine, and, after the lapse of a few minutes, the writing will be found reversed and eaten into the gelatin film as if it were engraved. By means of an India rubber roller a little common printing ink is spread over the plate and absorbed by the lines sunk by the alum, and again rejected on the application of moisture upon the paper laid down upon it and smoothed over it by the flat of the hand. When removed, this paper will have upon it the first impression of the writing or drawing. For each succeeding impression the plate must be inked, as in lithography, by the India rubber roller. A considerable number of impressions can be taken.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$55 00 @ 60 00
Pine, good	45 00 @ 50 00
Pine, shipping box	18 00 @ 22 00
Pine, common box	15 00 @ 17 00
Pine, common box, ⅝	14 00 @ 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	35 @ 40
Pine, tally plank, 1¼, 2d quality	35 @ 38
Pine, tally plank, 1¼, culls	25 @ 28
Pine, tally boards, dressed, good	28 @ 30
Pine, tally boards, dressed, common	22 @ 25
Pine, tally boards, culls, dressed	21 @ 23
Pine, strip boards, merchantable	16 @ 18
Pine, strip boards, clear	22 @ 25
Pine, strip plank, dressed, clear	33 @ 35
Spruce boards, dressed	20 @ 22
Spruce plank, 1¼-inch, dressed	22 @ 25
Spruce plank, 2-inch	25 @ — 35
Spruce wall strips	13 @ — 15
Spruce timber, per M	17 00 @ 20 00
Hemlock boards, per M	15 00 @ 16 00
Hemlock joist, 2½x4, each	15 @ — 16
Hemlock joist, 3x4	16 @ — 18
Hemlock joist, 4x6	40 @ — 44
Ash, good, per M	40 00 @ 45 00
Oak	50 00 @ 55 00
Maple culls	20 00 @ 25 00
Maple good	42 00 @ 65 00
Chestnut	45 00 @ 50 00
Cypress, 1, 1¼, 2, and 2½-inch	35 00 @ 40 00
Black walnut, good to choice	85 00 @100 00
Black walnut, ⅝-inch	75 00 @ 85 00
Black walnut, selected and seasoned	110 00 @150 00
Black walnut counters, per ft	12½ @ 25
Cherry, wide, per M	85 00 @100 00
Cherry, ordinary	60 00 @ 80 00
White wood, chair plank	60 00 @ 70 00
White wood, inch	30 00 @ 50 00
White wood, ⅝-inch	30 00 @ 35 00
White wood, ⅝ panels	35 00 @ 45 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 21 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	2 00 @ 2 15
Yellow dressed pine flooring	25 00 @ 30 00
Yellow pine girders	30 00 @ 40 00
Locust posts, 8 feet, per inch	18 @ 20
Locust posts, 10 feet	24 @ 25
Locust posts, 12 feet	29 @ 34
Chestnut posts, per ft	3 @ 3½
Basswood per M	25 00 @ 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.		Afloat.
Pale, per M.	5 25	@	5 75
Up Rivers	7 75	@	8 25
Haverstraw Bay	8 00	@	8 25
" " choice	8 50	@	8 75
Favorite Brands	9 00	@	— —
Hollow Fire-Clay Brick	9 00	@	9 25

FRONTS.

Croton—Brown, per M.	8 00 @ 8 50
" Dark	9 00 @ 9 50
" Red	9 00 @ 9 50
Philadelphia	21 00 @ 23 00
Trenton	21 00 @ 23 00
Baltimore	38 00 @ — —
Clark's Ottawa White	25 00 @ — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	35 00 @ 36 00
" Glengarnock	33 00 @ 34 00
" Eglinton	32 00 @ 33 00
" American, No. 1	40 00 @ 40 50
" American, No. 2	38 00 @ 39 00
" American, forge	37 50 @ 38 00

	Store prices.		Cash.
Bar, Swedes, ordinary sizes	— 6	@	— 6¼
Bar, Swedes, nail-rod	— 6½	@	— —

LEAD—PER 100 POUNDS.

*German	— — @ — —
*English, common	— — @ — —
*Spanish	— — @ — —
*Foreign, refined	— — @ — —
*Bar, and Pipe	6 50 @ 7 50
*Sheet	8 00 @ — —
*Domestic	5 50 @ 5 63½

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 70 @ — —
8d and 9d, common	3 95 @ — —
6d and 7d, common	4 20 @ — —
4d and 5d, common	4 45 @ — —
3d and 4d, light	5 20 @ — —
3d, fine	5 95 @ — —
2d, fine	5 95 @ — —
Cut spikes, all sizes	4 95 @ — —
Clinch nails, 1½ to 1¾ inch	5 95 @ 6 20
do. 2 to 2¼ inch	5 70 @ — —
do. 2½ to 2¾ inch	5 45 @ — —
do. 3 inch and longer	5 20 @ — —

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	8 25 @ 8 50
*I. C. coke, 10x14	7 25 @ 7 75
*I. X. charcoal, 10x14	10 50 @ 10 75
*I. C. charcoal, 14x20	8 25 @ 8 50
*I. X. charcoal, 14x20	10 50 @ 10 75
*I. C. coke, 14x20	7 25 @ 7 75
*I. C. coke, terne, 14x20	7 00 @ 7 25
*I. C. charcoal, terne, 14x20	7 50 @ 7 75

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 8⅜ @ — 8½
Sheet, (open)	— 9 @ — 9½

SOLDERS.

No. 1	— 13 @ — 14
No. 2	— 12 @ — 12½

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 80 @ — 85
Berlin Freestone, in rough	— 85 @ — 95
Berea Freestone, in rough	— 70 @ — 75
Brown-Stone, Portland, Conn	1 30 @ 1 35
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Dorchester, N.B., Stone, rough, per foot	— — @ 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 @ 7 25
Chalk, per 100 lbs	— 35 @ — —
China Clay, per ton gold	20 00 @ 22 00
Chrome yellow, dry, per pound	— 12½ @ — 28
Lead, red American, per pound	— 8 @ — 9
Lead, white American, pure, in oil	— 9 @ — 9½
Lead, white American, pure, dry	— 8¼ @ — 8¾
Lead, white English, pure, in oil gold	— 9½ @ — 10½
Litharge	— 7½ @ — 8
*Ochre, Fr., dry, per 100 lbs	1 50 @ — —
Ochre, ground, in oil, per lb	— 6 @ — 15
Ochre, Vermont, per 100 lbs	— 75 @ 1 00
*Orange Mineral, English gold	— 9½ @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, per lb	— — @ — 25
Putty, per lb	— 2½ @ — 3
Spanish Brown, dry, per lb	— 1⅜ @ — 1¼
Spanish Brown, ground in oil, per lb	— 8 @ — 9
Venetian red, per cwt	1 75 @ 2 00
*Vermilion, Chinese, per lb	— 85 @ — 90
*Vermilion, Trieste	— 70 @ — 75
*Vermilion, quicksilver, bags gold	— 60 @ — 62½
Vermilion, American, common	— 15 @ — 18
Whiting, per 100 lbs	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
*Zinc, white French, dry, (Red Seal) gold	— 8¼ @ — 9
Zinc, white French, in oil gold	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
do do	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

CEMENT—PER BARREL.

Portland (imported)	2 90 @ 3 25
Portland (American)	2 50 @ 2 75
Portland (Spanish)	2 50 @ 2 75
Portland (Lafarge)	3 20 @ 3 40
Portland (German, Bonner)	2 85 @ 3 25
Lime of Teil	2 20 @ 2 30
Lime of Teil, per ton	15 00 @ 18 00
Roman	2 75 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ — —
Rosendale	1 20 @ 1 25

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb. — 1¼ @ — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 12 @ — 14
Goat, " "	— 15 @ — 18

SLATE.

Purple roofing slate, per square	$6 00 @ 6 50
Green slate	7 00 @ 7 50
Red slate	10 50 @ 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 @ 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 @ — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 25 @ 3 50
Nova Scotia, blue	3 00 @ 3 25
Calcined, Eastern and city, per bbl	1 00 @ 1 15
Calcined, city casting	1 20 @ 1 25
Calcined, city superfine	1 30 @ 1 50

LIME—PER BARREL.

State, common	— 75 @ — —
" finishing	— 90 @ — —
Rockland, common, cargo rate	1 00 @ — —
" finishing	1 25 @ — —
Ground	— 85 @ — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 20 @ — 35
St. Domingo, crotches, fine	— 25 @ — 50
St. Domingo, logs, small	— 5 @ — 8
St. Domingo, logs, large	— 20 @ — 30
Frontera, Mexican, large	— 11½ @ — 16
Frontera, Mexican, small	— 8 @ — 10
Other Mexican	— 8 @ — 14
Honduras	— 10 @ — 15

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ @ — 6
Rio Janeiro, good to fine	— 5 @ — 8
Bahia, ordinary to good	— 2 @ — 6½
Bahia, good to fine	— 4½ @ — 8
Honduras, per ton	10 00 @ 20 00
Satin Wood, per foot	— 15 @ — 60
Tulipwood, per lb	— 6 @ — 12½
Lignumvitæ, small, per ton	10 00 @ 20 00
Lignumvitæ, large	25 00 @ 50 00

CEDAR.

Cuba, per superficial foot	— 10 @ — 12½
Mexican, small	— 8 @ — 10
Mexican, large	— 10 @ — 14
Florida	— 30 @ 1 50

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¼ inch.	$ 84	—
2.6 x 6.6	1¼	1 18	—
2.6 x 6.8	1¼	1 24	—
2.8 x 6.8	1¼	1 30	—

INSIDE BLINDS.

Per lineal foot, 4 folds, pine	56 @ — —
Per lineal foot, 4 folds, ash or chestnut	— 90 @ — —
Per lineal foot, 4 folds, cherry or butternut	1 07 @ — —
Per lineal foot, 4 folds, black walnut	1 30 @ — —

GENERAL REVIEW OF THE MARKETS.—The markets the past month have continued in a good healthy condition—a little stronger, if anything, than during the previous month. For this season of the year the volume of trade has been all that could be desired, there being a good demand for all classes of stock. Dealers are, as a consequence, in the best of moods, and generally bespeak a large increase of business this spring over that of the corresponding season last year. With the exception of iron, there has been no material advance in prices. On this, however, the rise has been very great, as may be seen by a comparison of this month's prices of that commodity with those given in our January issue.

THE MARKETS IN DETAIL.—In the brick market the past month trade has been very satisfactory, with prices firm. Arrivals have been moderate, and the amount afloat has never exceeded the demand. The remarkable open weather of January was very favorable for pushing forward work, and builders took advantage of this in completing jobs under way and commencing others that they were not contemplating to start on until later in the season.

In the lumber market there has been an active demand for all grades of goods, and business has kept close up to the available limits, which are of course small at this season.

In the lath market there has been more or less irregularity shown since our last, with matters to some extent doubtful as to the actual ruling value. It is difficult to obtain reliable figures at present; we hear of some large parcels being sold at $2.25, while immediately afterward comes the report of other parcels being disposed of at $2.

In the lime market prices have advanced, and the position at the present writing is very firm.

In the hardware market the amount of trade doing has been quite full for this time of the year, with demand constantly increasing and the tone very encouraging. Prices have continued steadily on the upward turn, and so strong and general has this tendency become, that many manufacturers have withdrawn lists entirely and agree to no prices except the ruling figures at the time of sale.

In the metal markets the "boom" which we noticed in our last report as having developed itself again, has continued more and more pronounced. Scotch pig has found a free, quick demand, with quite liberal sales, both on spot and to arrive. American pig has found an active and excited market, with buyers to be found for almost any delivery, and not a great many sellers to meet them, as the product of the furnaces has been so generally contracted for ahead. Values are, as a consequence, greatly stimulated, but there is no certainty in giving quotations, owing to the great buoyancy, and our figures must be considered nominal. Rails, both iron and steel, have met with a liberal demand, and heavy contracts have been closed with deliveries extending up to October next. For manufactured iron the tone of the market has been very strong, with a general good current demand. In the lead market domestic pig has ruled strong, with prices on the upward turn. Pig tin has met with a good demand, and buyers have given evidences of decidedly increasing anxiety, the effect of which has been to stimulate values. Tin plates have also met a good and increasing sale, with the general tone of the market in seller's favor.

In the paint market, for all seasonable goods, the demand has been on the increase, and the condition of trade has appeared to be prosperous and encouraging.

Sanitary Construction and Arrangements of Dwellings.

BY PROF. W. H. CORFIELD, M.A., M.D.

(*Continued from Page 10 of January Number.*)

We now come to speak of exit shafts and valves. The first and most important of these is the chimney, about which I have already spoken. I need only add here that it is advisable to do without the use of cowls on chimneys wherever it is possible. If the chimney can be made high enough it will not require a cowl, and if it cannot, a simple conical cap is generally sufficient to prevent down drafts. There is no doubt, however, that Boyle's fixed chimney cowl for preventing down draft, not only does so, but produces an up draft in the chimney when the wind blows down upon it, as can easily be shown; a small piece of wool is made to ascend in a glass tube by blowing vertically down upon the fixed cowl placed upon the top of it. Of revolving cowls for chimneys, the common lobster-back cowl is probably the best. While speaking of cowls, I may as well mention that a variety of cowls have been invented with the object of increasing the up draft in exit shafts of various kinds; some are fixed, as Boyle's, Buchan's and Lloyd's, and some revolving, as Scott, Adie & Co.'s, Howarth's, Stidder's, Banner's, Stevens', and the one invented by Mr. Boyle, but discarded by him some years ago. Whether any of these increase the up current in exit shafts is a matter which is still under investigation, but I can show, quite easily, that the common rough experiment, by means of which they are supposed to do so, is entirely fallacious. Cotton wool is drawn up a tube at least as easily by blowing across it in a slanting direction as by blowing through a cowl placed on the top of it. The fixed cowls have the advantage that they cannot get out of order; the revolving cowls have the disadvantage which is common to all apparatus with moving parts, that they are certain to get out of order some day or other. Whether they increase up drafts or not, there is no doubt that most of them prevent down drafts, and, like any other cover, prevent the entrance of rain. Openings are sometimes made high up in the chimney flue and protected by valves, one of the best of which is Arnott's, which consists of a light metal flap swinging inside a metal framework in such a way that it can open toward the chimney flue, but not toward the room. Any pressure of air from the room toward the flue will, therefore, open it and allow the air to escape from the room into the flue; pressure of air the other way will shut it. The disadvantages of this ventilator are that it makes an irregular noise, although this has been, to a considerable extent, obviated by the India rubber padding with which it is now fitted; it also occasionally admits a little soot, and of course air at the same time, from the flue into the room. Boyle's chimney ventilator is a modification of this. Instead of the light metal flaps there are a number of small tail flaps; these make little or no noise, but they are liable to be opened by a current of air in the chimney. It is obviously, it seems to me, at variance with sound sanitary principles to make openings from the interior of the room into the chimney flues, and then to trust to valves to prevent the air of the flue from coming in. A far better plan is to have shafts placed by the side of the flues, and this of course is better done when the houses are being built. The easiest and most satisfactory way of doing it is by means of air flues and smoke flues combined, in which the air flues are molded in the same piece of fire-clay as the smoke flue itself. These air flues can be connected with the upper parts of the rooms, and up drafts will be inevitably caused, as the air in them will be considerably heated on account of its immediate contact with the outer side of the flue. Such shafts can only serve as inlets when the flues are cold, and so it is advisable to use them especially with flues that are always hot—as, for instance, that of the kitchen chimney—and it is desirable, wherever it can be done, to connect the kitchen with a different air shaft from the other rooms, or it is possible the air from the kitchen may get into some of the other rooms of the house. Of exit ventilators not connected with the chimney flues, I may mention Mackinnell's, which also provides an inlet for air as well, and which is very useful in small rooms, closets, etc., having no rooms over them. It consists of two tubes, one inside the other, passing through the ceiling into the outer air; the inner tube is longer than the outer one, and projects above it outside and below it an inch or so into the room. At its lower end a circular rim is attached horizontally parallel to the ceiling. The outer air enters between these two tubes, and is deflected by the rim just mentioned along the ceiling, so that it does not fall straight into the room. The vitiated hot air passes out by the inner tube, the action of which is, of course, considerably increased if a gas burner or other light be placed beneath it. It is upon this principle that the lamps for lighting railway carriages are made, the reflector answering the purpose of the rim around the end of the inner tube, and the air to supply the lamp coming in between the reflector and the glass shade, while the products of combustion escape through the pipe leading from the middle of the reflector, and immediately over the flame. Of course Mackinnell's ventilator requires a cover to keep out the rain, and it is necessary in fact to have a double cover, so that the heated air which escapes by the inner tube shall not be carried back into the room by the entering air. Tossel's ventilator is a variety of this, with a cover by means of which advantage may be taken of the action of the wind. The same inventor has also contrived one which can be used between the ceiling of one room and the floor of the room above, provided that this space can be well ventilated.

(*Conclusion next Month.*)

Some Facts About Ice.

The ice crop this season bids fairs to be a short one, although it is a little early yet to predict anything like a famine. Last winter 10,000,000 tons were gathered in the country, and it is thought that not much more than two-thirds of it has been used. There are annually gathered and housed along the northern shores of the lakes and tributaries, for the use of the trade, over 2,000,000 tons; in New York, Brooklyn, Jersey City and vicinity, about 2,000,000 tons; in the New England States, 2,000,000 tons; in Philadelphia, 700,000 tons; in Boston and vicinity, 825,000 tons; in Baltimore, 400,000 tons; and in other parts of the United States, over 2,000,000 tons.

The best ice is that cut in December and January, that cut later being snowy and less dense. Fresh pond ice is said to be the best for shipping purposes, as it is denser and heavier than any other kind; while ice that has been kept over for two or three seasons is considered preferable for shipping.

The extent of the industry of cutting and gathering ice along the Hudson, can be judged from the fact that it gives employment to fully 10,000 people for several months in the year, and disburses for labor alone over $1,000,000 annually. It is estimated that fully 40,000 people are dependent upon ice gathering for food and habitation. The total capacity of the Hudson river ice houses is 2,226,075 tons, which, if sold at 75 cents per ton on the spot, would make a total of $1,669,556. If this ice were all stored in one ice-house, 100 feet wide by 30 feet high, it would require to be *seven miles* in length to accommodate it all.

KEY-HOLE SAW.—The Japanese hand-saws cut on the pull-stroke; so no matter how hard the wood or dull the saw, they will not bend or buckle. It is rather more difficult to saw to line with such saws than with ours, but they have their advantages. Take one of our key-hole or compass saws, cutting on the push or shove stroke—what an aggravating, limber thing it is. Now point the teeth the other way, and you have a tool that will keep stiff no matter how many knots it encounters or how dull it gets. In other words, the pull-stroke of 3,000 years ago is the best for such thin, narrow blades.

Absinthe.

Absinthe as an exhilarant, the use of which originated in Paris, has now become quite common in England and various other parts of Europe, and even in some parts of the United States. Absinthe, as made in France, whence it is exported, is a mixture of the essence of wormwood, (absinthium), sweet flag, anise seed, angelica root, and alcohol. It is colored green with the leaves or juice of the smallage, spinach, or nettles, and sometimes with blue vitriol, to give it as well a certain required taste. It is said that chloride of antimony (commonly called butter of antimony) is another adulterant; but this is denied.

The proportion of essence of wormwood to alcohol is 5 drachms of the essence to 100 quarts of alcohol. Its bitterness increases the craving or desire for it, and the *habitué* is soon unable to take food, unless he is primed for it by the deadly provocative. On the nervous system the influence is different from that of alcohol. The absinthium acts rather after the manner of nicotine, but it is slower in taking effect than the alcohol which accompanies it; consequently there is felt by the drinker, first, the exciting, relaxing influence of the alcohol, and afterwards the constringing, suppressing influence of the wormwood. The drinker is left cold, tremulous, unsteady of movement, and nauseated. If the dose be large, these phenomena are exaggerated, and the voluntary muscles, bereft of the control of the will, are thrown into epileptiform convulsions, attended with unconsciousness, and eventually the epilepsy becomes confirmed with confirmed indulgence. The effect which the absinthe exerts in a direct way on the stomach alone, is highly pernicious. It controls for mischief the natural power of the stomach to secrete digestive fluid; it interferes with the solvent power of that fluid itself, so that, taken in what is considered to be a moderate quantity—a wineglassful or two in the course of the day—it soon establishes a permanent dyspepsia.

Humbug No. 7.—Bourbonnel's Fire without Fuel.

The anxiety respecting the coal question is now forever settled. The papers report that M. Bourbonnel, of Dijon, France, the celebrated lion and panther slayer, happened upon the following discovery by chance, and after six years' persistent investigation, brought it to entire "workable" perfection. He discovered, by means of two natural substances—inexhaustible in nature—the means of lighting and maintaining a fire without wood or coal; a fire instantaneously lighted and extinguished; a fire causing no dust, smoke, or trouble; a fire costing only $^1/_{10}$ as much as one of ordinary fuel; and, what is more wonderful still, the portion of the fire which answers to our fuel, is everlasting—that is to say, would last a lifetime. M. Bourbonnel's invention comprehends both stove and fuel. The fires could be on the minutest scale or the largest—they could be used for heating a baby's food or for roasting an ox; being lighted instantaneously, they will be a great economy in the saving of time.

M. Bourbonnel at once patented his invention, and a number of engineers and savants from Paris visited him, and pronounced his discovery one of the most remarkable of the age. He has had several offers for the purchase of the patent in France, but wants to sell it in England, his own occupation being in another line. Any English gentleman or firm wishing to see his fires and stoves, can do so by writing to him a day or two beforehand. His address is, M. Bourbonnel, Dijon.

The reporter of this great invention, Mrs. Edwards, well known in England as a writer, and whose statements consequently must be believed, adds: "I have seen these fires and stoves. There is no mistake about the matter; it is as clear as possible that here we have a perpetual and economical source of fuel. Two hundred years ago the discoverer would have surely been roasted as a wizard." An appropriate epitaph in such a sad event, it occurs to us, would have been: "Well done, good and faithful servant."

Home Department.

The Old Oaken Bucket.

(As Revised and Edited by a "Sanitarian.")

[The following parody, by J. C. Bayles, on that familiar poem, "The Old Oaken Bucket," is so cleverly written, and hits so forcibly the evils resulting from the ignorance that prevailed regarding sanitary matters in the "good old days," that we are induced to depart from a custom which we have almost uniformly adhered to in excluding poetry from our columns, and publish the verses without further apology.]

With what anguish of mind I remember my childhood,
Recalled in the light of a knowledge since gained;
The malarious farm, the wet, fungus-grown wildwood;
The chills then contracted that since have remained;
The scum-covered duck-pond, the pig-sty close by it,
The ditch where the sour-smelling house-drainage fell;
The damp, shaded dwelling, the foul barn-yard nigh it—
But worse than all else was that terrible well;
And the old oaken bucket, the mold-crusted bucket,
The moss-covered bucket that hung in the well.

Just think of it! Moss on the vessel that lifted
The water I drank in the days called to mind,
Ere I knew what professors and scientists gifted
In the water of wells by analysis find.
The rotting wood fiber, the oxide of iron,
The algæ, the frog of unusual size,
The water, impure as the verses of Byron,
Are things I remember with tears in my eyes.

And to tell the sad truth—though I shudder to think it—
I considered that water uncommonly clear,
And often at noon, when I went there to drink it,
I enjoyed it as much as I now enjoy beer.
How ardent I seized it with hands that were grimy,
And quick to the mud-covered bottom it fell;
Then soon, with its nitrates and nitrites, and slimy
With matter organic, it rose from the well.

Oh! had I but realized, in time to avoid them,
The dangers that lurked in that pestilent draught,
I'd have tested for organic germs and destroyed them
With potassic permanganate ere I had quaffed;
Or, perchance, I'd have boiled it and afterward strained it
Through filters of charcoal and gravel combined,
Or, after distilling, condensed and regained it
In potable form, with its filth left behind.

How little I knew of the dread typhoid fever
Which lurked in the water I ventured to drink;
But since I've become a devoted believer
In the teachings of science, I shudder to think.
And now, far removed from the scenes I'm describing,
The story for warning to others I tell,
As memory reverts to my youthful imbibing,
And I gag at the thought of that horrible well,
And the old oaken bucket, the fungus-grown bucket—
In fact, the slop-bucket—that hung in the well.

Mental Disturbances.

Dr. Maudsley, the eminent physiologist, in an article on the "Pathology of the Mind," says: "As a very little child, I remember I attached a peculiar importance to certain numbers—this or that trivial action must be accompanied by counting so many, or the action must be repeated so many times; later, certain of these numbers asumed a special importance; three, or any multiple, must be avoided in ordinary action, as being in some sort sacred to the Holy Trinity. An imperative necessity seemed laid upon me to touch or move this or that object, though I might have no desire to do so; and as, I think, is related of Dr. Johnson, I would submit to no little inconvenience to avoid treading on the joints of the paving stones. Generally, I may say that which was least pleasant seemed most strongly obligatory; for example, if I chanced to be walking with any one, the impulse to pick up a chance straw in the path was much stronger than if I were alone, though (or, perhaps, because) I was very sensitive to fear of my peculiarities being known; and again, though I was fastidiously particular as to cleanliness, I was especially impelled to touch some dirty or offensive object. I remember putting myself to considerable trouble to go out again, after reaching home, to move some trifling thing which I had chanced to notice on the pavement."

A Heat-Saving Device.

The enormous wastefulness of our methods and appliances for burning fuel is one of the most important problems that confront the inventor. Beginning with coal in the mine, we waste from 50 to 60 per cent of it in the operation of mining; and after this, by the most ingenious appliances, we can hardly get 25 per cent of its calorific value in actual use. This enormous percentage of loss is due chiefly to imperfect combustion, by which a portion of the fuel falls through the grate

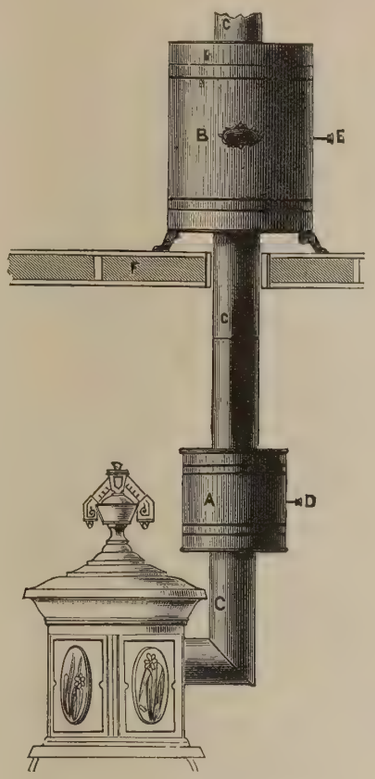


Fig. 1.

unburned, or is passed out at the chimney in the form of smoke, (unburned carbon and hydrocarbon vapors), and to the imperfect utilization of the heated combustion products, by which they are passed out of the chimney at a high temperature. There are other

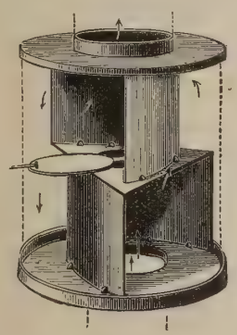


Fig. 2.

causes of this low efficiency, which in special cases acquire importance, but those named above are invariably present as the chief elements of waste in the use of fuel.

The remedy for many of the troubles attending the use of the solid fuels employed universally for industrial and domestic purposes, is to substitute for coal and wood a fuel in the gaseous form; but though the desirability of this substitute has long been recognized by engineers, sanitarians, and economists, the radical changes which its manufacture and introduction necessitate, must render the innovation a gradual one—to be realized in general practice only after many years.

Meantime, inventors are not idle in devising methods and appliances for saving a portion of the vast quantities of heat that are blown out of innumerable chimney-stacks. We illustrate herewith one of these devices—in external and sectional views—known by the trade name of the "Walker Heat Multiplier." It is simple in its construction, and should be effective in accomplishing considerable saving of heat that would otherwise be passed off unused, and also indirectly in economizing to some extent in fuel consumption. The construction and action of the device will be understood by an inspection of the accompanying cuts, and from the following description: It consists of a triangular cast-iron center plate, provided with a damper to regulate the draft, and two curved flue plates of sheet iron, all of which are shown in position in Fig. 2. When the damper is drawn out, a full direct draft is given and the full benefit of the apparatus is not obtained. When the damper is closed, however, the heated gases of combustion are obliged to pass in a roundabout way through the apparatus, making a circuit in so doing equal to about three times its hight. By this artifice the heated gases, which would ordinarily be passed directly upward and out of the chimney, are arrested, as it were, and retained for a time in contact with the surfaces of the apparatus, imparting to them a notable percentage of the heat which would otherwise have been lost, and which the apparatus gives out to the surrounding air by radiation and convection.

The device can be applied, as desired, to a great variety of heating or cooking apparatus—from the large furnace, for example, to the parlor stove. It is manufactured and sold by the American Co-operative M'f'g Co., 170 La Salle street, Chicago, Ill., from whom further details may be obtained.

The Law of Rest.

William Walter Phelps recently made an address on the American habit of hard work before a meeting of physicians and surgeons. Among other things, he said: We are a nation without contentment, without rest, without happiness. In a feverish race, we pass from the cradle to the grave—successful men, to whom life is a failure. Our boys leave the university, when English boys leave their school. Our merchants leave their trade, retiring to some more dignified or honorable work, as they believe it, at an age when the German merchant first feels the master of his trade. We are always anticipating the future, forcing the task of a whole life into part. Worse, we are not content with doing a year's work in a month in our own calling, but we must do enough in all other callings to win distinction there. In other lands it is enough to be a lawyer, physician, clergyman, merchant. Here we are nobodies unless we fill the sphere of all human occupations. He must be a statesman, and know political science as if already in office. He must be an orator, and ready to persuade and instruct—a wit to shine at the dinner-table—a literateur, a critic. There is too much human nature in man for this to mean anything except a discontented life and a premature death. And the remedy?

Correct public opinion. We must honor the man who faithfully does his task, whatever it be. Not the task, but the faithfulness with which it is done, must be the measure of the honor. Then men will be content with their father's house or their father's trade. This will give us that family association which is a sure pledge of good conduct and patriotic love. This will give us too that traditional aptitude which alone gives great mechanical excellence. It will not be a bad time for American manufacturers when we find stamped on them, what Mr. Griffis finds on Japanese bronzes—"Done by the ninth bronzer in this family." Then men will keep the occupation of their youth for their age, and having leisure, will build the foundations broad enough to withstand bankruptcy. Then men will seek excellence in other callings, and not compete with the excellent in other callings. Then men will alternate labor with rest, and obey the demands of nature.

Politeness.—Politeness costs nothing. It is just as easy to be polite as gruff and bearish. No one is more

benefited by true courtesy than the business man, whether that courtesy is exercised by himself or his subordinates. We know of some establishments from which reliable customers have repeatedly been driven, never to return, simply because salesmen and saleswomen have failed in the courtesy appropriate to their positions. There are many such in the city. On the other hand we know of many business places that are continually thronged with customers, simply because the attendants, as well as the principals, are polite and attentive, and seemingly desirous of pleasing. Depend upon it, nothing pays better than politeness in business.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

It is understood that Judge Hilton proposes the erection of a large store, similar to and adjoining the one just built for him on 23d street.

The Liverpool, London & Globe Insurance Company will soon commence the erection of a building on William street, for the company's own purposes.

William Shickel, the architect, is preparing plans for a store, with a front of 71 feet 6 inches on Union Square, and 120 feet 7 inches on 18th street. It will be of brick, terra-cotta, and Pennsylvania blue-stone, and will cost $200,000. The owners are Arnold, Constable & Co.

The Eighth Avenue Railroad Company have made a contract with a prominent contractor to remove all the ruins from the site of their burned stables, and put the ground in order for the new buildings. It will require a month or six weeks for the contractor to remove the ruins and put the ground in order for rebuilding, but when this has been done work on the new structures will begin at once. Many of the bricks, girders and beams in the old building can be used again.

The Improved Dwellings Association is the name of a company made up of wealthy citizens, organized with a capital of $500,000, for the purpose of erecting improved tenement houses for the poorer classes of the city. They have just made the purchase of twenty-one lots bounded by First avenue, 71st and 72d streets. It is vacant property, near the river, with excellent drainage facilities and good air. The building to be first constructed will be built upon a square of sixteen lots, and it is expected that it will be finished within a year. Efforts will be made to erect tenements upon the most improved plans, which yet can be rented at from $8 to $12 per month for each set of apartments. The association are looking for some suitable place down town where they can put up similar buildings.

The annual report of the Superintendent of Buildings shows that during the year 1879, 2,065 buildings, costing $22,567,312, were erected in this city, an increase of over $7,000,000 on 1878. The following table shows the number of buildings erected since 1868, and their estimated cost:

Year.	No. of Buildings.	Estimated Valuation.
1868	2,014	$34,517,068
1869	2,342	40,352,058
1870	2,351	34,668,998
1871	2,782	42,585,391
1872	1,782	27,884,870
1873	1,311	24,936,535
1874	1,388	16,667,417
1875	1,406	18,226,870
1876	1,379	15,903,880
1877	1,432	13,365,114
1878	1,672	15,219,680
1879	2,065	22,567,312
Totals	21,876	$306,895,807

On the last day of 1879, 1,045 buildings were in progress, against 741 at the close of 1878. The class of buildings erected during the year may be subdivided as follows:

Class.	Number.	Estimated Cost.
First-class dwellings	764	$10,362,400
Second-class (two families)	253	1,018,650
French flats	253	3,672,200
Hotels	1	25,000
Tenements	399	3,537,750
First-class stores	32	1,126,000
Second-class stores	11	78,500
Third-class stores	16	20,475
Offices	12	364,500
Factories	80	699,914
Schools	6	166,000
Churches	5	33,200
Public buildings	22	824,050
Stables	85	391,753
Frame houses	126	246,900
Totals	2,065	$22,567,312

Distributing the above among the various wards, the following is the result:

Wards.	No. of Buildings.	Estimated Cost.
First	11	$271,200
Second	3	106,000
Third	2	160,000
Fourth	5	36,000
Fifth	17	169,850
Sixth	5	77,900
Seventh	14	143,450
Eighth	29	407,054
Ninth	41	351,450
Tenth	10	79,000
Eleventh	25	115,150
Twelfth	668	4,649,895
Thirteenth	12	51,950
Fourteenth	13	421,000
Fifteenth	17	509,650
Sixteenth	30	282,800
Seventeenth	19	121,325
Eighteenth	24	382,635
Nineteenth	678	10,564,350
Twentieth	53	476,300
Twenty-first	41	892,395
Twenty-second	162	1,753,033
Twenty-third	158	568,525
Twenty-fourth	28	38,000
Totals	2,065	$22,567,312

Miscellaneous.

The new State Capitol at Albany, N. Y., is ready for its iron roof over the Assembly Chamber portion, and the room to be occupied by the Court of Appeals has been re-arranged for the temporary use of the Senate.

A New York company of English capitalists is about to erect at Denver, Col., on Capital Hill, forty separate residences, each to cost about $3,500. They are to be built of brick, fitted with modern improvements in four styles, all two-story structures. W. W. Goodrich, architect, has drawn the plans and forwarded them to New York city for the approval of the company.

Miscellaneous and Advertising.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

Judges McKennan and Butler, in the United States Circuit Court, have entered a decree for an injunction and an account against John C. Rohrman for an infringement of letters-patent of William Austin, of the firm of Austin, Obdyke & Co., of Philadelphia, for the manufacture of expanding conductor or water pipe. This is the third adjudication in favor of this well-known firm.

The *Berkshire* (Mass.) *Courier* says: "An 'agent' for the Manufacturer and Builder, *Scientific American*, and various other publications, is perambulating through Berkshire, offering those journals for the past year (1879) for the small sum of 50 cents. He is reported as having 'scooped' in a goodly number of shekels in this town. When his subscribers get their papers, they will read them with much interest."

There is no artisan who can afford to be without "Moore's Universal Assistant." This highly useful work contains over 1,000,000 industrial facts, and is of the greatest value for those engaged in the mechanic arts, while for the general reader it has a vast amount of information in relation to matters of every-day life which every one should know. The publisher is R. Moore, No. 20 Cooper Institute, New York.

The Chester Steel Castings Co., office, 407 Library street, Philadelphia; works, Chester, Pa., have within the last few months doubled the capacity of their works by lengthening their main foundry building, and adding to it an L 60x80 feet, and have also erected a larger furnace, a larger steam engine and boilers, etc. They are doing double the work they were in the spring; are filling orders for steel castings from nearly all the locomotive builders in the United States, also from railway companies, engine builders, machine shops, agricultural implement manufacturers, and for wood-working machinery.

A syndicate has been formed, composed of the following parties, who have organized the Metropolitan Fuel-Gas Company: Philip Kissam, representing William Astor; Edwin D. Morgan, Wm. Walter Phelps, Abram S. Hewitt, James S. Pinchot, A. S. Barnes, H. B. Hyde, Henry Day, Walter E. Lawton, Sidney A. Stevens, and several other capitalists. This company has secured the exclusive right to the Strong process for the city of New York, deriving their right from the American Gas-Fuel and Light Company, of which latter company M. H. Strong, the inventor, is President, and William B. Buck, Secretary. We were among the first to endorse and publish the particulars of this process, and it is a pleasure to note the active steps that have been taken for its general introduction.

Design for a Row of City Houses.

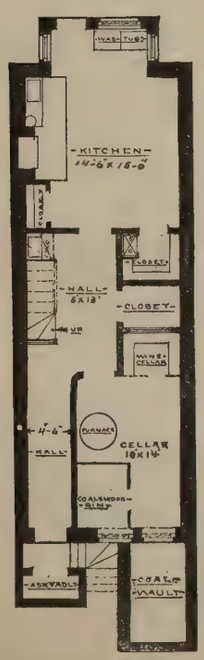
We publish this month a design for a row of six picturesque city houses, by Mr. Wm. H. Beers, architect, of 150 Broadway, this city. These houses are to be built on lots of 16 feet 8 inches frontage, and are to have a depth of 45 feet; the fronts are to be laid up with the best quality of Philadelphia brick, laid in black mortar joints, with sill courses, etc., of Connecticut brown stone; they are to be three stories high, with roof, and each to have picturesque gables. The idea has been to design a row of houses that will meet the requirements of small families, and at the same time be less costly and a departure from the ordinary stereotyped brown-stone houses built by speculative builders. It has been the aim of the architect to adapt this design for those whose means are limited, and for such it will be found infinitely more desirable than the present style that is found repeated on every street in the city.

On the first floor are located a hall or reception-room, staircase hall, butler's pantry, and dining-room; on the second floor in front, is the parlor, having a bay-window; in the rear is the principal bedroom, with closets and bath-room adjoining. The third floor is divided into three bedrooms, one large room in front and two in the rear. Over the rear, on the third story, the walls are carried up to a sufficient hight to admit of servants' bedrooms. In the rear of the basement is located the kitchen, with closets, and hall leading to front basement door. In front is the cellar, well lighted by windows in front wall. There are to be coal vaults under sidewalk, and ash vaults under stoop.

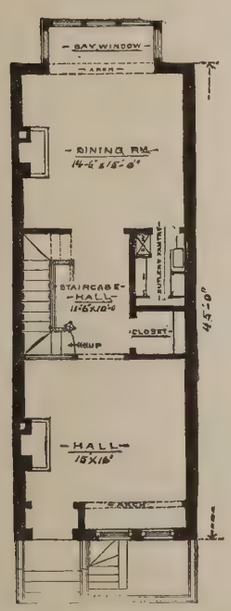
The arrangement is rather a novel one; having one large room or hall in front on first floor, may seem at first glance a waste of space, but in a 16-foot house, after taking off the necessary width for hall and partition, there is left a room so narrow for the parlor that it becomes useless, and one that it is impossible to furnish; but in this case, having a room or hall the full width of the house, with an open fire-place, an ornamental wooden mantel, and pictures hanging on the walls, a larger appearance is given to the house, and a room is secured that can be utilized and furnished to advantage.

These houses, built in the best manner, finished in hard wood on first floor, and hall and parlor on second floor finished in like manner, would cost $5,000 each.

DESIGN FOR A ROW OF CITY HOUSES.—W. H. BEERS, Architect.



Basement Plan.



First Story Plan.

Second Story Plan.

High vs. Low Factory Buildings.

We find in the *American Exchange and Review* an article on the comparative vibration and fire hazard of high and low factory buildings which appears to us to be of such special interest that we republish it in full:

"A late article, by a Boston underwriter (mutual) of textile mill risks, states that in many New England mills the vibration will, in the loftiest structures, cause water to slop over from a pail two-thirds full, if the pail be placed on one of the highest floors. Gas pendants show corresponding vibration [plainest when loosely hinged] by swaying two to three inches. Such tremor, though in less degree, has been noticed in heavily built four-story stone mills, and even in those having iron floors with brick arches. In one of the last-named kind, it became necessary, before satisfactory work could be done, to put wooden blocks in the walls, upon which the iron girders might rest. Looms are always located across the mill, when its length is greater than its breadth, which is now usually the case, to prevent such jarring. It seems, however, almost impossible, with all efforts, to prevent jarring and tremor; and these are not only hard on shafting and hangers—the main ends of shafts often running in wall-boxes—but especially detrimental to cog wheels, and to any delicately-set machinery, like carding machines, etc. Not only are such machines injured, but the fiber passing through them is not so evenly worked as if they were on a firm base.

"There is another view of this subject, increasing the disadvantage from vibration. It is in accordance with natural laws, just as iron constantly jarred becomes more granular in texture and weaker in cohesive force, that walls of brick or stone subject to constant tremor shall become disintegrated and weakened. In such a case the work of the fire is partly done before ignition commences. The buildings may not fall before a fire, as in the case of the large Pemberton mills some years ago, but when fire attacks a factory whose walls have for years been shaking, as with a chronic chill, the whole building is likely to fall into one mass of ruin early in the fire, or else the fire be much more extended by the falling of some of the long-shaken walls, than if they had been able to resist the suddenly added molecular vibrations of intense heat. There is undoubtedly a difficulty in strengthening wooden girders with iron rods and trusses, for, in case of fire, such compound girders are weaker than ones of wood only, because, trusting to iron, they are frequently overloaded; and it is during strong heat that the weakness of iron becomes apparent. Rectangular iron knees to brace girders to walls are objectionable, because, in a fire, when the interior pillars yield, the ends of girders in the wall may so hold that the leverage of the long timber will pull the walls inward. It should be remembered that by the intense heat of a fire heavy walls are temporarily weakened, but if strong enough to stand, their strength returns after cooling, and they can often be used in case of rebuilding or restoring.

"Synchronous vibration is very dangerous to any structure, and for this reason platoons of soldiers are never allowed to march over even the strongest bridge; they must 'break step,' and walk with irregular tread. We believe an individual once declared that with his fiddle he could so set a certain bridge vibrating that it would fall. We do not vouch for the report that fear of the catastrophe prevented a trial, but will only remark that the story illustrates the principle involved in mill vibration.

"It is a fact that in mills of ordinary construction a safe form for stability, and for low rate of fire destructibility, is two stories high, extending over sufficient space to give the room required. It is safe to assume that equal cubic content, with double the base area, has but one-half the fire loss liability of the double altitude, with conditions otherwise equal. Add to the fire result of difference in hight, the effect of the greater vibration of the higher structure, and the hazard of higher structure is yet further augmented. The two-story building has the advantage of the perfectly dry second floor for the accommodation of carding machines, in which machines wooden cylinders and leather card-clothing may be injured, or prevented from doing perfect work, if on a damp ground-floor. The second floor will also support all the shafting; the machinery on the upper floor having belts running from pulleys below. It is self-evident that a two-story mill, even if not properly built, would naturally shake less; and for several other reasons the walls are more likely to stand after fire, than in case of factories having many lofty stories. A one-story mill with cement floor—and especially, if all the roof be of iron—is the safest fire risk any manufactory can offer; but next to it comes the two-story mill, which, for many kinds of work, is far more convenient and easier to operate than the other, while always as much cheaper as a floor is cheaper than a roof; and in a city but half the amount of costly ground would be needed. If such a two-story mill had, at proper intervals, strong dividing brick walls, extending several feet through the roof, and iron doors for communication, *sliding into* the wall, not only would such division wall brace the building so as to prevent vibration, but it is probable that in case of fire only one compartment, and perhaps only one story of that compartment, would be seriously injured."

SOME INTERESTING STATISTICS.—An enthusiastic devotee of the science of statistics has ascertained the exact percentage of railway passengers that miss their trains at the Vienna stations. Beginning his observations at a single station, he found that out of from 5,400 to 5,800 passengers leaving every day one man and from two to three women were the average number of late comers. Then he took in all the stations, and placed the number of tardy passengers at ten per day. Of every 100 there were 29 men and 71 women. The statistician was not surprised that the male sex should show to advantage, but the disproportion astonished him when he reflected that many men are delayed by the fault of their wives, while the contrary seldom occurs. More people miss local trains than express trains, the proportion being as three to one. In winter the number of these unfortunates is least and in the warm months of July and August it is greatest.

New Publications.

The Sugar Beet; Including a History of the Beet Sugar Industry in Europe, Varieties of the Sugar Beet, Examination, Soils, Tillage, Seeds and Sowing, Yield and Cost of Cultivation, Harvesting, Transportation, Conservation, Feeding Qualities of the Beet and of the Pulp, etc. By Lewis S. Ware, C. E., M. E., etc. Illustrated by Ninety Engravings. Philadelphia: Henry Carey Baird & Co., 810 Walnut street. 1880. Price $4.

The author of this work is an American engineer, who has devoted a number of years to the study of the beet sugar industry as practiced with great success in France and other countries of continental Europe, and who has prepared a very admirable and thorough treatise on the subject in all its bearings, as a labor of love, with the view of drawing the attention of his countrymen to one of the most remarkable industries of modern times, that more careful and systematic efforts may be made to naturalize it upon American soil. The ground covered by the book is concisely expressed in the title, and the reader will find, on reference to it, that no important point having a bearing upon the requirements of the prospective industry from the standpoint of American conditions, has been overlooked. The author writes with the thorough conviction that the beet sugar industry will ere long be established in this country on a firm and enduring foundation, and that it will in time acquire the magnificent proportions it has attained in France and Germany. He gives a synopsis of the several attempts that have thus far been made to introduce the industry into this country, and holds that the non-success of these efforts has been due to the want of information, which he has attempted to supply. His picture of the probable results which would follow the introduction of the beet sugar industry in the United States, and which he in common with others who have given the subject their careful attention, feel warranted in predicting, from the almost marvellous benefits that have sprung from its establishment in other countries, is well worth examination.

Starting with the fact that we send $80,000,000 out of the country every year to purchase foreign sugars for home consumption, the author urges that this money should be expended in the employment of home labor. To fully supply the home demand would require 900 beet sugar factories, turning out a yearly product of about one and a half billion pounds of sugar. This would necessitate the cultivation of 800,000 acres of land in beets, or, making due allowance for the rotation of crops, of 3,200,000 acres. The production of beets from this acreage would be 27,000,000,000 pounds. The working of these would require the consumption of 1,730,000 tons of coal. In addition to the sugar yield, we should have residual products of great value—5,500,000,000 pounds of pulp, which, as cattle food, would represent 30,000,000 pounds of meat, and about 1,000,000,000 pounds of molasses, which, when converted into alcohol, would represent 31,000,000 gallons. The industry on the scale here contemplated, would give employment to 270,000 men, women and children, and would open a new market for coal, coke, bone black, chemicals, iron, steel and copper, entering into the construction of the elaborate machinery required, to say nothing of building materials. Thus employment in new avenues would be given engineers, chemists, agriculturists, and to those employed in every industry that would be drawn upon for supplies for its support and maintenance. The loss to the government of the $40,000,000 now received in the form of duties on imported sugars, he holds, would occasion no complications, since this would be more than made up in other ways; as, for example, by the taxation of the alcohol distilled from the molasses. Here the author will, no doubt, meet with the opposition of certain vested interests, but his position is unassailable, since it would be preposterous to assume that the country at large would not be immensely the gainer by the development of a home industry of such magnitude and importance as this.

The intelligent interest that is now being manifested on the subject of domesticating the beet sugar industry by several of the States, the knowledge that the soil and climate of a large portion of our Northern, Middle and Western States are quite as suitable for the cultivation of the sugar beet as those of the most favored localities of Europe, and the knowledge that nothing but the intelligent adoption of the methods that have been followed abroad, is necessary to establish it as a home industry of the first magnitude, inspires us with the confidence of the author in the belief that the time is near at hand when the hopes of its friends will be realized. To all these we can commend Mr. Ware's book, with the assurance that they will find in it much practical information that cannot be found elsewhere in the English language.

Another indication of the growing interest in this subject, is afforded by the announcement that an "Illustrated Quarterly," devoted to the cultivation and utilization of the sugar beet, is shortly to appear, under the joint editorial direction of the author above named and Dr. Robert Grimshaw.

New and Original Theories of the Great Physical Forces. By Henry Raymond Rogers, M.D. Published by the Author. 1879.

The peculiar ideas advanced in this little volume are, with the disadvantage of being presented in greater detail, substantially those which were severely criticised by the late editor of this journal in our issue for December, 1879, in an article entitled "Light and Heat." We have examined the book with care, to find some reasonable evidences to support the "new and original theories [vagaries?] of the great physical forces" presented by the author; but beyond his statement in the preface that "he has ever been unable to accept the usual explanations" universally acknowledged to be valid, we can find none.

The scientific errors, gross misconceptions, and unwarranted assumptions with which the work abounds, have already been so forcibly shown up in the criticism of the author's views in the article of our predecessor above quoted, that we do not feel ourselves called upon to take up the task of refuting them in detail, but prefer to drop it with the remark that the errors and fallacies which our predecessor so clearly exposes and refutes are fair samples of the errors with which the book abounds, and that we endorse his criticism to the fullest extent—that almost every page of the work proves that the author knows very little of the subject of which he treats.

We will, however, give the author credit for advancing his erratic vagaries with a certain degree of propriety and modesty, as a glance at his apologetic preface will show, and not with the impudent assurance of the charlatan. But while this is evidence of the possession by the author of the good taste to acknowledge that he may be mistaken, it does not lessen the responsibility he has voluntarily assumed of disseminating a good deal of error and not a little nonsense, which may harm others more than himself.

The Lumberman's Hand-Book for the Inspection and Measurement of Lumber and Logs. Second edition, revised. Chicago: W. B. Judson. 1879.

The second edition of this little hand-book, which is of special value to the lumber trade, is just received, showing some enlargement and other evidences of editorial revision. It will be found to be of special value to any one at all interested in the buying and selling of logs or lumber—hardwood or soft—containing as it does full information respecting the various systems of inspection, grading and measurement in vogue. The volume is neatly gotten up, and is a mark of the enterprise which characterizes the *Northwestern Lumberman.*

OTHER PUBLICATIONS RECEIVED.

Vick's Floral Guide. No. 1. 1880. Rochester, N. Y.: Jas. Vick.

The Tribune Almanac and Political Register for 1880. Edited by Edward McPherson. New York: The Tribune Association. Price 25 cents.

Correspondence.

HUMBUG NO. 5 AGAIN—LIGHTNING ALL AROUND THE HORIZON.

To the Editor of the Manufacturer and Builder:

I am glad to see you denouncing the Chambers lightning-rod in the November number of your journal. I denounced it as a humbug and a fraud in the *College Quarterly*, and warned our people against its use. Two of the agents of the company visited me and told me that unless I retracted what I had said against the rod, they would sue me for damages. One of the "scientific men," a "professor," as he called himself, remained about here for a week, telling what the company would do unless I retracted.

I enclose a circular, from which you will see what kind of a retraction I made. When such men as Profs. Tyndall and Rowland say that such rods, "instead of protecting buildings, tend to promote their destruction," it is certainly time all respectable journals were warning the people against them. These rods are actually in use in portions of this State, in Ohio, Georgia, and Texas, according to the statements of the company.

The company has filed a bill in the United States Circuit of this State for $50,000 damages against me, for slandering this lightning rod. Of course they know that it will avail them nothing, but it is their policy to "bulldoze" everybody they cannot buy. They have received such a blow in this State that they will find their rods poor property, and I intend to get a bill through the Legislature this winter prohibiting the sale of such rods in this state. Very respectfully,

J. K. Macomber.

State Agricultural College, Ames, Iowa, Jan. 14, 1880.

We give, in what follows, a portion of the circular referred to by Prof. Macomber, which makes very interesting reading. It is entitled "Lightning-Rod Humbugs," and opens in this wise:

"The article in the September *Quarterly* on lightning-rod humbugs has stirred up considerable feeling in certain portions of the State. The writer supposed he was doing the public a service in warning it against the use of a useless, and even dangerous lightning-rod. It seems, however, that the Chambers lightning 'protector' is backed by a powerful corporation which is making money out of it. Davenport seems to be the home of the so-called 'protector,' and the Davenport *Gazette* and *Democrat* its champions. I have circulars in my possession in which both of these papers laud this new invention to the skies. They seem to favor the 'protector' because it is a Davenport affair, unmindful of the people outside of their city who will be imposed upon by purchasing it. I have been accused of being enlisted in the interests of certain lightning-rods, and denounced for my presumption in unmeasured language. About six weeks since, the proprietor of the 'protector' sent two agents to this college to investigate the Professor of Physics, and see whether he was in his right mind. These 'scientific' men of the company brought along their machines with which to prove the scientific character of the new lightning 'protector.' The 'scientific' man was allowed an excellent opportunity to explain his new rod before a large and intelligent audience, and it was the universal opinion that he had nothing new to exhibit, and that the Chambers lightning 'protector' was a humbug. But this was not enough; after failing to convince our judgment of the value of the rod, the writer was informed that unless a retraction of 'the offensive language' used in the last number of the *Quarterly* was written, the 'instructions of the Home Company would be carried out.' In other words, I would be called upon to pay the costs of a lawsuit and $50,000, or less, damages. In order to discover whether I was right or wrong in the matter, the following circular was printed and sent to a large number of scientific men, eminent physicists and electricians of America:

"*Dear Sir:* The people of the Western States have been imposed upon by lightning-rod peddlers more perhaps than by any other class of swindlers. Among other rods sold in Iowa, is one known as the Chambers rod, which has been patented by the Chambers National Lightning Protection Company, of Cincinnati, O. Briefly, this system consists of an iron rod running along the ridge of the building, with points at each end projecting upward. It is supported upon large glass insulators, and has no electrical connection with the building, and no rod running to the ground. Many public buildings in this State have been furnished with these rods. In view of these facts, and in order to collect evidence from eminent authorities respecting the best method of protecting buildings, I beg leave to submit the following interrogations: 1. Is good ground connection highly important? 2. Other things being equal, what is the best material for lightning-rods? 3. How large a cross section should an iron rod have? (A copper rod?) 4. Are glass insulators, on the whole, of much value? 5. Should the rod be connected with a metal roof, and with water or gas pipes near it in the building? 6. Should the rod be pointed with some metal that will not tarnish easily? 7. From the description above given of the Chambers rod, what is your opinion of it? You will confer a great favor by forwarding answers to the above at your earliest convenience. Please answer fully question No. 7. Any suggestions on the subject will be gladly received."

"Up to October 15th, answers have been received from the following, whose answers to question No. 7, I give below:

"*From Prof. Loomis, of Yale.*—Very dangerous. It is of no value whatever for protection, and so far as it produces any effect, it would tend to attract the lightning from the clouds, without affording any medium for transmitting the electricity safely to the earth. Nobody but a charlatan would recommend a lightning-rod which had no metallic connection with the earth.

"*From Prof. Young.*—If it has no thorough connection with the ground, it is worse than useless—an absolute invitation of danger.

"*From Prof. Rowland.*—It is the worst humbug that has appeared in this line, and the proprietors of the patent should be arrested for selling the rod under the false pretense that it will protect a building.

"*From Prof. Clarke.*—It is absolutely useless. In theory, it rests upon the total misapprehension of some of the simplest physical laws. I have investigated it thoroughly. I have seen the Chambers experiments, and know that no scientific man would endorse it for a moment.

"*From Dr. Kedzie.*—It is a scientific humbug.

"*From Prof. Anthony.*—It is worse than useless. It would increase the danger.

"*From Prof. Harvey.*—My opinion is that it might be ornamental, but that it is worthless, if not dangerous. Better have nothing at all.

"*From Prof. Rood.*—Worse than useless.

"*From Prof. Trowbridge.*—I think it is a humbug; for the discharge would not respect the details between the rod and the building. Moreover, the electrical discharge will not necessarily strike such a rod in preference to the larger conductor which the building affords.

"*From T. A. Edison.*—I do not wish to be drawn into any controversy on the subject, but will simply state that the rods on my buildings all connect with the earth.

"*From Prof. Davies.*—I should regard it as I regard much of the iron ornamental work put upon towers and around houses—that is, as adding to the risk of being struck by lightning.

"*From Prof. Silliman.*—That it is in flagrant violation with every accepted principle of electrical science, and should be prohibited, if need be, by legislative enactment.

"*From Prof. Todd.*—I should think it admirably planned for drawing the electric discharge through the building.

"*From Prof. Le Conte.*—Such rods would afford no protection; on the contrary, they would be dangerous.

"*From Prof. Newcomb.*—If it has no connection with the ground, I should not like to be under it during a thunder-storm.

"*From Prof. Pickering.*—I should not use it.

"*From Prof. Mayer.*—From the description given by sentence, 'It is supported,' etc., to (.) period, I should say that the Chambers rod is utterly useless."

Prof. Macomber then proceeds to show how lightning-rods should be put up, in accordance with the views which obtain universally amongst those who are acquainted with the fundamental principles of electricity. We may find room for this portion of the circular in our next month's issue.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2575) Effect of Plants on the Health.—Will you please inform me whether plants kept in the house are injurious to the health of the inmates. My wife and I are fond of plants, and have a number in our sitting-room.—W. I. N., South Boston, Mass.

(2576) Properties of the Magnet.—1. I have a 2-foot magnet; could I magnetize twenty 6-inch steel bars of the horseshoe form with it? 2. We read in "Parker's Philosophy" that a magnetizing magnet loses none of its power by being thus employed. Is this so? 3. We read again, in the same work, that the effect produced by two magnets used together, is much more than double that of either used alone. "Chambers' Encyclopedia" says not—that induced currents interfere. Which is correct?—J. P. McD., Galveston, Tex.

(2577) Velocity of Descent of a Rifle Ball Fired Vertically.—We have had considerable argument in regard to the velocity of a rifle-ball in its downward course after being forced upward from a rifle to its utmost hight. Will it return with the same speed and penetrating power as it attained when leaving the rifle?—A. C., Montville, N. J.

(2578) Commercial Value of Sulphuric Acid of Different Gravities.—I have offered me three lots of sulphuric acid; one lot of 66° B. at 1½ cents per pound, another of 60° at 1¼ cents, and a third of 50° at 1 cent. I have been told I would get more acid for the money by buying the 66° acid at the higher price. Will you kindly enlighten me.—C. H. H., Philadelphia, Pa.

(2579) Uses of Fluor Spar.—Having control of what is represented to be a considerable deposit of fluor spar, will you please advise me of the uses of this mineral, and if it is of any great value?—P. S., Hoboken, N. J.

(2580) Concerning Mica.—Will you tell me if a mica mine would be valuable?—P. S., Hoboken, N. J.

(2581) Color-Changing Compounds.—I have met somewhere in my reading an account of certain chemical salts that were exceedingly sensitive to heat, changing color very strongly even by moderate heating. I would like to refer to them, and will be obliged to you if you can give me any references to the published accounts of these substances, or if you could give in your journal some account of them.—J. E. J. B., Portland, Oregon.

(2582) Lubricant for Wooden and Iron Cogs.—What is the best lubricant for wooden cogs working on iron?—B. T. J. Garrison, Md.

(2583) Boiler Covering.—Will lime, hair and sawdust, mixed together in equal parts, make a good covering for boilers?—G. B. W., York, Pa.

REPLIES.

(2575) Effect of Plants on the Health.—We are of the opinion that the popular belief that our correspondent echoes—that plants kept in the house are injurious to the inmates, is purely fanciful. Under the influence of sunlight the leaves of plants absorb carbonic acid from the atmosphere and decompose it, yielding back the life-supporting oxygen, from which the inference might be justified that they were rather wholesome than otherwise. On the other hand, it has been shown that when the influence of light is withdrawn, this action of the plant is temporarily suspended—the plant sleeps, and the excess of carbonic acid gas taken up during the day is given off at night; and because of this action, the presence of plants in sleeping apartments has been thought to be unwholesome or injurious. We think the bad effects to be attributed to plants from this cause are too trifling to be worth serious consideration. The inhabiting of sitting and sleeping apartments warmed by baked air drawn from foul cellars, (which is the condition of existence in a considerable percentage of town and city houses), the neglect of means to secure proper ventilation, especially in sleeping apartments, and the poisoning of the atmosphere of dwelling houses by the entrance of sewer gases through leaky traps, are very real and common dangers, compared to which the one alluded to by our correspondent sinks into utter insignificance, if indeed it be worthy to be considered at all.

(2576) Properties of the Magnet.—1. Yes. The mode of procedure will be found described in any work on natural philosophy. 2. A magnet does not lose power by being so employed. 3. As you put this question, "Chambers' Encyclopedia" is correct. It is well known, however, that a compound magnet, made up of a number of plates or layers, each of which is separately magnetized, will possess greater carrying power than a simple homogeneous magnet of equal weight. This is explicable by the fact that such thin plates can be more readily and perfectly magnetized to saturation than larger masses; so that when properly superposed, the portative strength of such a compound magnet is greater than that of a single magnet of equal weight. There is a limit, however, beyond which there is no advantage in multiplying these plates, as our correspondent will discover should he make the experiment, as each plate serves to neutralize in a slight measure the polarity of its neighbor. The effect of this neutralization, when a certain limit has been reached in the number of the plates, will be to offset the advantage derived from the more perfect magnetization of the single members of the series, and further multiplication of the plates beyond this limit will be positively disadvantageous.

(2577) Velocity of Descent of a Rifle Ball Fired Vertically.—Yes; and the reason for this reply will appear from the following explanations, to wit: When a body—say the rifle ball of our correspondent—is thrown up vertically, the hight to which it rises depends upon the amount of force with which it was propelled. The velocity of its ascent is constantly diminishing, since it suffers a retardation from two causes—the action of gravitation and the resistance of the air, the combined influence of which shortly suffices to bring it to rest; and when it descends, under the influence of gravitation, its constantly accelerated velocity of descent (in accordance with the laws of falling bodies) at each point along its path is precisely equal to that which it possessed at the same point during its ascent. As the body during the period of its fall encounters the same resistance from the air as it encountered during its rise, this factor may, for the present, be ignored. To understand the case, we must bear in mind that the body, during the time of its ascent, is, so far as the influence of gravity is concerned, practically the same as a falling body; in other words, it obeys the same law that a falling body obeys. So, while a body falls to the earth with a constantly accelerated velocity, the body projected into the air will show the influence of gravitation by exhibiting a constantly accelerated retardation. Let us suppose the case of a rifle ball projected vertically upward with any given velocity. If it were not acted on by force of gravitation, it would, in obedience to the laws of motion, continue on forever in the same straight line at the same rate of speed. But as a body falling freely from a state of rest would acquire an acceleration of the velocity of its fall at the end of 1, 2, 3, 4, 5, 6, etc., seconds, of 32⅙, 64⅓, 96½, 128⅔, 160⅚ and 193 feet respectively, so the rifle ball, during the time it is going up, being all this time under the influence of gravitation, which acts in a direction opposite to that of its upward motion, suffers a corresponding retardation of its motion. Omitting the factor of the resistance of the air, (which does not affect the

principle here involved, as it retards the ascent just as much as the descent), we would have for our rifle ball going up the following velocities: Let us assume that our rifle ball leaves the gun with a velocity of 960 feet per second; and as we are simply illustrating a principle, let us, to simplify matters, drop the fraction, and call the retardation of gravitation at the end of one second 32 feet. Then the velocity of our rifle ball would be, at the end of

TABLE I.

1 second	960	minus	32=928 feet.
2 seconds	960	"	2×32=896 "
3 "	960	"	3×32=864 "
4 "	960	"	4×32=832 "
5 "	960	"	5×32=800 "
6 "	960	"	6×32=768 "
25 "	960	"	25×32=160 "
26 "	960	"	26×32=128 "
27 "	960	"	27×32= 96 "
28 "	960	"	28×32= 64 "
29 "	960	"	29×32= 32 "
30 "	960	"	30×32= 0 "

In other words, at the end of 30 seconds our rifle ball will have come to rest, and its descent will have begun. With these figures at hand, it will be easy to ascertain the spaces passed over by the ascending rifle ball in successive seconds, and the total hight which it attained. For example, the hight to which the rifle ball would have risen at the end of 1, 2, 3, etc. seconds; if it were not acted on by gravity, would have been 960, 2×960 =1920, 3×960=2880 feet. But the attraction of gravitation, which is constantly acting in a direction opposite to that of its flight, and which, as we have seen, causes a body to fall towards the earth, at the end of 1, 2, 3, etc. seconds, 16, 64, 144 feet, etc., respectively, has impeded the upward motion of the ball by just this amount. This may perhaps be shown more clearly in the accompanying table:

TABLE II.

Distance the ball would travel in virtue of its original projectile force.		*Retardation due to gravitation, in feet.*	*Actual hight of rifle ball, in feet.*	*Spaces passed through in successive seconds.*
At the end of 1 second	960	16	944	912
" " 2 seconds	1,920	64	1,856	880
" " 3 "	2,880	144	2,736	848
" " 4 "	3,840	256	3,584	816
" " 5 "	4,800	400	4,400	784
" " 6 "	5,760	576	5,184	—
" " 25 "	24,000	10,000	14,000	144
" " 26 "	24,960	10,816	14,144	112
" " 27 "	25,920	11,664	14,256	80
" " 28 "	26,880	12,544	14,336	48
" " 29 "	27,840	12,456	14,384	16
" " 30 "	28,800	14,400	14,400	

At the end of 30 seconds, it appears from the table, the retardation due to gravitation has neutralized the projectile force, and the ball commences its descent. This would take place as follows, in obedience to the law of falling bodies, that "the whole spaces passed over by a body falling freely from a state of rest, are proportional to the squares of the times occupied in falling, while the spaces fallen through in successive times increase as the odd numbers 1, 3, 5, 7, 9," etc.

TABLE III.

Ball falls in		*Total distance fallen.*
1st second	16 feet	16× 1^2 = 16 feet.
2d "	48 "	16× 2^2 = 64 "
3d "	80 "	16× 3^2 = 144 "
4th "	112 "	16× 4^2 = 256 "
5th "	144 "	16× 5^2 = 400 "
6th "	176 "	16× 6^2 = 576 "
25th "	784 "	16×25^2 =10,000 "
26th "	816 "	16×26^2 =10,816 "
27th "	848 "	16×27^2 =11,664 "
28th "	880 "	16×28^2 =12,544 "
29th "	912 "	16×29^2 =13,456 "
30th "	944 "	16×30^2 =14,400 "

Thus, it appears, the ball reaches the ground at the end of 30 seconds, or in precisely the same time it occupied in reaching its extreme hight. To show that the ball on its downward path retraces each point of its upward path at precisely the same velocity which it possessed at the same point during its ascent, it will only be necessary to compare the figures of tables II. and III., which is done in table IV., viz.:

TABLE IV.

Ball Rises		*Ball Falls*	
During the last second of its ascent	16 feet.	16 ft.	during the 1st second.
During the 29th second,	48 "	48 "	" 2d "
" 28th "	80 "	80 "	" 3d "
" 27th "	112 "	112 "	" 4th "
" 26th "	144 "	144 "	" 5th "
" 6th "	784 "	784 "	" 25th "
" 5th "	816 "	816 "	" 26th "
" 4th "	848 "	848 "	" 27th "
" 3d "	880 "	880 "	" 28th "
" 2d "	912 "	912 "	" 29th "
" 1st "	944 "	944 "	" 30th "

The ball therefore reaches the earth with the same velocity, and consequently with the same penetrating power, that it left it, occupying the same time in its descent as in its ascent, and passing through each point in its downward course with the same velocity that it passed through it in ascending. As remarked at the outset, we have ommitted taking the resistance of the air into account in this example, for the reason that it does not affect the principle involved, for it retards the rise just as much as it does the fall of the ball. And we have taken only the approximate value of the distance fallen through by a body, to avoid unnecessary complications by introducing fractions. To render the calculation strictly correct, our correspondent will call the distance a body falls from a state of rest during the first second 16 1/12 feet, and its accceleration of velocity at the end of the first second 32 1/6, instead of the whole numbers we have taken. To provide for the retarding influence exerted by the resistance of the air, it will be necessary to apply the law that "the resistance of the air increases as the squares of the velocities." The retardation from this cause which will have to be subtracted from the distance the ball passes through in each second in rising and falling, will be, in the first second, ½ foot, and for subsequent seconds of fall or rise as follows:

TABLE V.

Seconds.	*Velocity in vaccuo.*	*Retardation in each second from resistance of air.*	*Actual fall during each second.*
1	16	½ foot	15½
2	48	(9×½)= 4½ feet	43½
3	80	(25×½)=12½ "	67½
4	112	(49×½)=24½ "	87½
5	144	(81×½)=40½ "	103½

As the velocity of the fall in successive seconds is 1, 3, 5, 7, 9, etc., times that of the first second, so the resistance of the air increases as the squares of these figures—that is, in the order 1, 9, 25, 49, 81, etc., from which values in table V. have been obtained.

(2578) COMMERCIAL VALUE OF SULPHURIC ACID OF DIFFERENT GRAVITIES.—Your informant is right. The oil of vitriol of commerce contains more or less water, a fact which is determined by taking its specific gravity with the hydrometer. The heavier the liquid the greater is the percentage of anhydrous (dry) sulphuric acid it contains; and *vice versa*, the lighter it is—that is, the more nearly it approaches to the specific gravity of water, the less sulphuric acid does it contain. Elaborate tables have been calculated by several authorities giving the percentage of anhydrous sulphuric acid in 100 parts of sulphuric acid at different densities, which are designed to meet just such cases as yours. These tables will be found in Dr. Ure's "Dictionary of Manufactures," and in almost any complete work on technical and general chemistry. The question you ask will be answered by the following simple calculations: From Dr. Ure's tables above referred to, sulphuric acid of 66° B. contains 81.54 per cent of dry acid; 60° acid contains 65.33 per cent; and 50° acid, 50.5 per cent. In other words,

100 lbs. 50° acid,	costing	$1,	would contain	50.5	lbs. dry acid.
100 " 60° "	"	1.25,	"	65.33	" "
100 " 66° "	"	1.50,	"	81.54	" "

From this showing it is easy to calculate how many pounds of each of the acid samples you would have to buy to get 100 pounds of dry acid, and the relative cost in each case would determine the question of economy. Thus, to get 100 pounds dry acid with the 50° sample, you would have to buy 198 pounds,

$$50.5 : 100 :: 100 : x \text{ ; or } x = \frac{100 \times 100}{50.5} = 198.$$

In the same manner, to get 100 pounds dry acid with the 60° sample, you would have to buy 153.16 pounds; and of the 66° sample, 122.63 pounds. By introducing the element of cost in the three cases, finally the question is settled. Thus:

198 pounds 50° acid at 1 cent, costs $1.98.
153.16 " 60° acid at 1¼ cents, costs $1.91.
122.63 " 66° acid at 1½ cents, costs $1.84.

From which it appears that the 66° acid at 1½ cents is cheapest; the 60° acid at 1¼ cents comes next, while the 50° acid at 1 cent is the dearest. The difference is certainly very small, but if you are using large quantities of acid, your saving by buying the 66° acid might prove to be considerable. In a galvanizing works, for example, where from 50 to 100 carboys of acid per week were consumed, the saving would foot up in a year to hundreds of dollars.

(2579) USES OF FLUOR SPAR.—While there is no market for a great quantity of fluor spar, there is, we think, a steady demand for it in certain lines of industry. We name in what follows the more important uses of this mineral, from which our correspondent may know to whom to address himself in disposing of it. It is used in its native condition, coarsely or finely powdered, as a flux in the metallurgy of copper, iron, and other metals. Particular reference should be made here to the smelting of copper ores associated with considerable gangue, or mineral impurities, which must be gotten rid of, and this is frequently best effected by the use of this substance, which acts as a flux. In Mr. Henderson's process of manufacturing iron and steel, which is practiced to some extent here and abroad, fluor spar is one of the essential articles employed for the elimination of phosphorus and other impurities. It is used also, though we believe only to a limited extent, in glass manufacture; some manufacturers adding it to their charges in small quantities, because of its property of increasing the fusibility of the glass, and thus saving fuel. It is thought by some also that it improves the strength of the glass. Fluor spar is used to some extent for the production of hydrofluoric acid, by gently heating a mixture of the coarsely powdered mineral with about twice its weight of oil of vitriol, in a retort or other vessel of lead. This acid is a powerful solvent, and is useful in the laboratory of the chemist. But its principal use is for etching glass. For this purpose it may be used either in the form of a dilute solution in water, or in the form of vapor. The glass articles are covered with an even film of beeswax or paraffine, the design is cut through the wax, and the article is immersed in the solution, or is laid with the engraved side over the vessel in which the acid vapor is being given off, so that it shall be exposed as directly as possible to the fumes. Hydrofluo-silicic acid is another compound made from fluor spar, for which a number of uses have been suggested in the arts. It is of some value to the chemist in analytical work, but has few or no commercial applications. The above may give our correspondent some useful hints as to where to apply to dispose of his deposit of this mineral.

(2580) CONCERNING MICA.—The same correspondent makes the above inquiry. In replying, we beg to inform him that the question is altogether too vague to enable us to answer properly. There is a good demand for clear mica in merchantable sizes, and if our inquirer owns or controls a deposit that will yield this article, he has a very good prospect of realizing handsomely from it. The mica, to be merchantable, must be clear and transparent, free from markings or stains of iron and other impurities, and in plates not less than 3 or 4 inches square. The clearer the stuff and the larger the sheets the more valuable it is. From these general points our inquirer may judge if his particular deposit fills the bill.

(2581) COLOR-CHANGING COMPOUNDS.—Our correspondent alludes most probably to the double iodides of silver and mercury and of copper and mercury, the remarkable behavior of which was first noticed by the German chemist Meusel, and described by him in the *Berichte* of the Ger. Chemical Soc., 1870. The first of these substances is prepared by adding a solution of nitrate of silver to one of iodide of mercury dissolved in iodide of potassium. The resulting precipitate has a bright lemon-yellow color, which, on being heated, turns at once to a deep orange, returning again to yellow on cooling. The other salt, in which the color changes are still more decided and striking, is prepared by adding to a warm solution of iodide of mercury in iodide of potassium some sulphate of copper solution, and then sulphurous acid. A brilliant carmine-red salt is precipitated, which turns brown, and finally intensely black, on being heated, returning back again to its original color on cooling, as in the former case. These changes occur below the temperature of 212° Fah. To show these changes well it is best to mix the dried precipitated salts, especially the carmine one, with a little gum water, and paint them on thin pasteboard, when the color changes can be shown in a most instructive way. By placing any object of metal, slightly heated, for an instant in contact with or close to the pasteboard, an image of the object will instantly appear; and a number of striking experiments may be exhibited with it, which the ingenuity of an experimenter may devise. This curious behavior of the carmine salt has suggested its utilization in several ways. Prof. A. M. Mayer, of the Stevens Institute, for example, has made it serve his purpose in obtaining a precise method of tracing the progress and of determining the boundary of a wave of conducted heat—a question of much interest in the higher departments of physics. (*Vide American Journal of Science*, ix., 37). This gentleman, in connection with Prof. G. F. Barker, now of the University of Pennsylvania, suggested that this carmine salt (and others) be applied to pillow-blocks and other parts of machinery liable to injurious heating by friction. As these salts exhibit their characteristic color changes within the limits of the freezing and boiling points of water, the carmine salt for example changing from brilliant red to a brown-black, becoming darker with each additional increasement of heat applied, a glance at the part would suffice to advise the attendant of the condition of the moving parts of his machine, often inaccessible to any other mode of observation, and therefore liable to serious damage before the discovery is made. If we are not mistaken, these gentlemen took out a United States patent for this idea about the year 1871. Finally, we may add that the interest excited by the announcement of this curious phenomenon, led to further investigations. Of these, the most important were those of Prof. E. J. Houston, (*vide*, *Journal of the Franklin Institute*, lxii., 115). This investigator found, as the result of a great number of experiments, that *nearly all metallic salts* possess the same property of color sensitiveness to heat, to a greater or less degree. He also discovered that in every case the color in its change approached the red or heat end of the spectrum. To enumerate all the phenomena observed by Prof. Houston, would be taking too much of our space, therefore we must refer our correspondent to his original communication.

(2582) LUBRICANT FOR WOODEN AND IRON COGS.—Bauer recommends the collecting of the oil drippings from the machinery and pouring into it melted waste tallow until it forms a smeary mass, and then mixing it with very fine, sifted glass powder. The cogs are rendered hard as well as smooth by the glass being pressed into the pores.

(2583) BOILER COVERING.—Almost any composition of which lime, clay or plaster forms the body, and which when dry will have sufficient tenacity to adhere firmly, will make a reasonably good insulating covering for steam boilers. The mixture you name will most probably be as good as any other, although we prefer the asbestos covering as prepared by the H. W. Johns Manufacturing Co., of this city.

THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 3. MARCH, 1880. TWELFTH YEAR.

Improved Hydraulic Press Pumps.

The accompanying illustration represents a system of pumping designed to be used in connection with the hydrostatic press, and is claimed by its manufacturers to do away with certain objections which render the use of that admirable machine, under certain circumstances, impracticable, or inexpedient, where it would otherwise be highly desirable. As commonly employed, the hydrostatic press works at a uniform speed throughout the entire distance travelled by the piston; the action of the machine is slow, and to obtain the best results it is necessary that the press be located near to the pump that feeds it. The pump herewith illustrated is affirmed to obviate these objections, by providing means for the acceleration of its action during the earlier portion of its work, and by a construction which permits of the location of the pump wherever it may be found convenient.

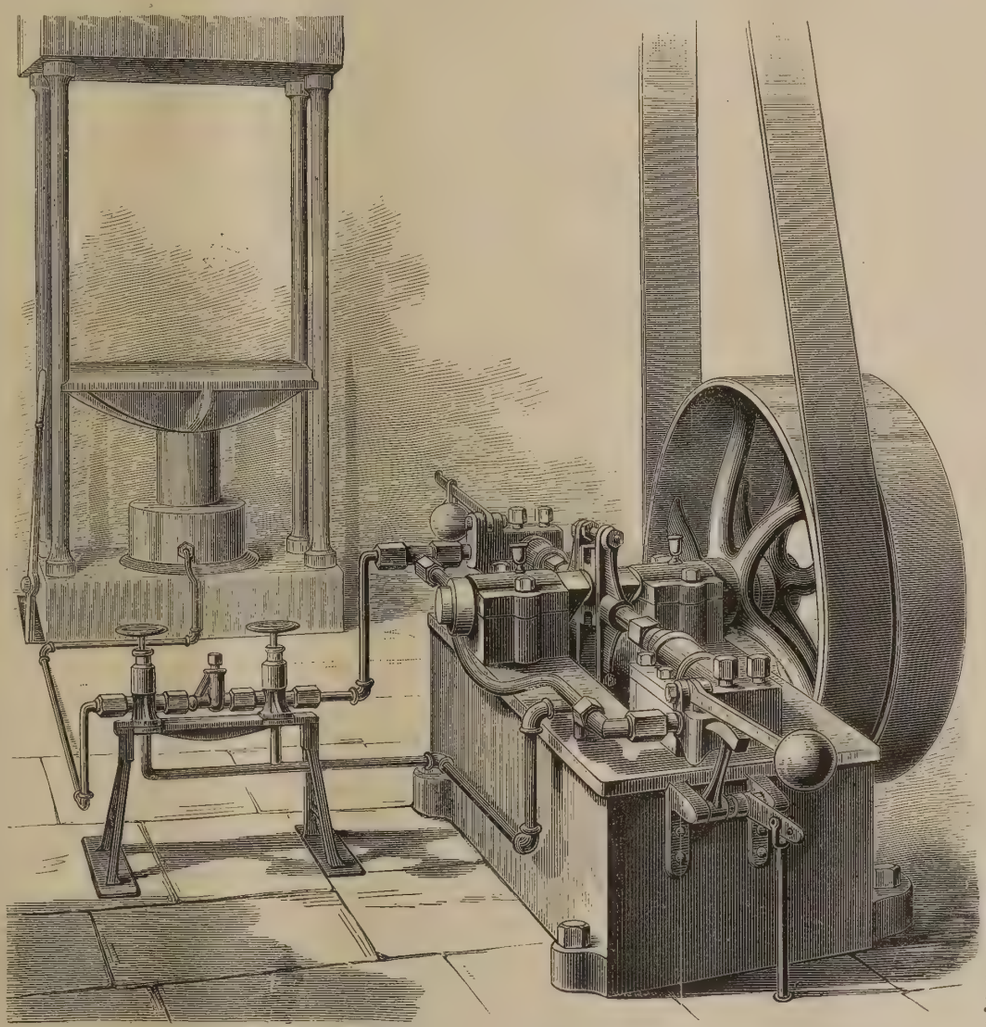
The following description of mechanical details, with an inspection of the engraving, will suffice to render the special features of this improved system of pumping comprehensible: The pump has two pistons, one of which is larger than the other, and designed to be applied at the beginning of the operation of pressing, to supplement the smaller one, and to accelerate the plunger of the press by forcing large quantities of water into the press cylinder. When the prescribed limit of pressure for the larger pump is reached, the pump is thrown off by means of the lever seen at the side of the press in the background. This lever is connected by bell cranks and shafts with the cam seen under the relief valve lever of the larger pump; the heavy finishing pressure is given by the smaller pump.

The valves to these pumps are of large area, and are so arranged that they may be readily taken from their seats to remove any foreign substance, or for the purpose of refitting, should this become necessary. All of the parts subjected to wear are capable of being easily "taken up," and the machine is constructed on the interchangeable plan. By employing a set of valves, shown in the middle of the engraving, the pump may be placed in any convenient position, no matter how far distant from the press. The press will then be controlled by these valves, while the pump is allowed to run continuously.

Pumps are made on this plan with four or six plungers. By modifying the arrangement of the valves, several presses may be conveniently operated with a two-plunger pump.

We are informed that a large number of these pumps are in use on a great variety of work in all parts of the United States, giving good satisfaction. Many of them are in the hands of parties having little mechanical skill.

The manufacturers are E. Lyon & Co., of 470 Grand street, New York.



HYDRAULIC PRESS PUMP.

Another Northeast Expedition.

Nothing daunted by his recent rough experiences in the Polar Sea, the indefatigable Prof. Nordenskjöld, in a letter addressed to M. Sibiarakoff—one of the patrons of his former expeditions—has expressed the intention of undertaking another voyage of discovery to the northern coast of Asia. He is reported to have written as follows: "After my return, I think of spending a year in preparing an account of the voyage of the *Vega*, and it is my desire then to continue the exploration of the icy ocean along the coast of Siberia, making the river Lena the point of departure, and the 'New Siberian Isles' the basis of operations. For the object, I have proposed to myself—namely, the rendering of the northern part of Asia completely accessible to commercial shipping. The prosecution of these researches is of paramount importance."

Prof. Nordenskjöld's devotion to the task of this exploration, and his former experiences, make him especially well qualified to fully solve the problem of the possible commercial importance of the new highway between the two oceans that his courage and persistence enabled him to successfully pass through.

Whether this will result in greatly increasing the facilities of commercial intercourse by demonstrating that the passage of the Polar Sea, from ocean to to ocean, can be made without unreasonable dangers and delays, may well be doubted from what has already transpired concerning his late experiences; but whatever the result, the final solution of the long-mooted question will lend additional renown to a name that already ranks the first on the roll of the heroes of Arctic exploration.

It may be interesting to our readers, finally, to read the following brief summary of Prof. Nordenskjöld's recent hazardous expedition, based upon the accounts that have appeared concerning it, from which it would seem that the commercial aspects of the Northeast passage are highly interesting and important:

"From several recently published accounts we have been able to glean some facts of considerable geographical and commercial interest in connection with the recent remarkable expedition of Prof. Nordenskjöld in traversing the Polar Sea from the Scandinavian Peninsula to the Japan Islands. He notices that the coast of Siberia, west of the Lena, is a vast, treeless plain. The absence of islands is unfortunate for the navigation of these waters, since this circumstance favors the driv-

ing of the ice floes by the winds down upon the shore. For several hundred miles about the mouth of the Lena, the presence of the warmer currents proceeding from it and neighboring rivers, and of a chain of islands, act as a barrier to the ice. Toward Behring's Strait, however, the conditions are again unfavorable. The most interesting of Prof. Nordenskjöld's discoveries, is that of a group of islands off the Siberian coast, which has been called the New Siberian Group, and are remarkable for the immense abundance of fossil remains with which they are strewn.

"Prof. Nordenskjöld sums up the results of his discoveries, in their commercial aspect, as follows: He is of opinion that the Northeast passage from the Atlantic to the Pacific may be made (probably) every year, and that it will certainly be often repeated. At the same time, he acknowledges that trade between the two oceans can only indirectly benefit by his discoveries. He believes that he has effectually demonstrated that a properly organized trade communication between Europe and Yenesei is practicable, and that the same can be conducted in such a manner that underwriters will as willingly take risks on vessels engaged in it as they now insure against the perils of the China Sea. Further than this, he holds that experienced navigators need fear no serious obstacles in the way of passing yearly, from the Pacific on one side and the Atlantic on the other, to the mouth of the Lena. He deems Siberia, with its vast extent of territory, its immense rivers, the richness of its soil, and its other natural resources, to be comparable to the same conditions in North America 150 years ago, and thinks that the future development of this rich tract of Asia may yet equal that attained in the past by the United States."

The Siemens Furnace in the United States.

From Richmond & Potts we have received the following facts and figures relating to the progress made in introducing the regenerative gas furnace, for various purposes:

The total number of Siemens furnaces in the United States, exclusive of a few used in chemical, glass and zinc works, is 208. Of these, 129 are for heating and puddling; 40 for open-hearth steel melting; and 39 for crucible steel melting. Of these, there were constructed during 1879, for heating and puddling, 13; for open-hearth steel melting, 7; and for crucible steel melting, 1. A comparison of the figures for 1878 and 1879 will show the progress that is being made in this direction;

	1878.	*1879.*
Heating and puddling	116	129
Open-hearth steel melting	27	40
Crucible steel melting	40	39
Total furnaces	183	208

The open-hearth furnaces mentioned above, represent, in 1878, a capacity of 140,000 gross tons; in 1879, 200,000 gross tons. The capacity of the crucible furnaces is almost 40,000 gross tons per annum. It will be observed that little or nothing is being done towards increasing the crucible steel capacity. This is ascribed to the advantages possessed by the open-hearth process.

Fire Losses in the United States.—On the authority of the *Fireman's Journal*, it appears that the amount of losses in the United States by fire during 1879, as reported to insurance companies, was $77,103,700; add to this the uninsured losses that are not reported, and it will fall but little short of the $100,000,000 claimed as the annual loss in this country. Canada is not included in these reports. In the four years, 1875–6–7 and 8, there were burnt wholly or in part, in the United States: 1,354 hotels, 283 churches, 182 school-houses, 40 court-houses, 42 almshouses, hospitals and asylums—1,881 in all. It would naturally be supposed that buildings of the character named would be built with more than ordinary care, but the record does not show such to be the case. Indeed, the more pretentious the building, the more careless seem to be the architects.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

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Special Edition to Wood-Workers and general Steam Users.

The great success that attended the issue of the special editions of our journal last year, to saw and planing mills and general wood-workers, has encouraged us to publish another extra, and we have decided to devote our April number to this purpose. We propose to publish ten thousand extra copies of that number, in addition to our regular issue, which we shall send to leading wood-workers and general steam users throughout the country. The attention of advertisers is called to this announcement, and our experience leads us to believe that they will not be slow in appreciating the benefit to be derived in being represented in this special spring number. The satisfaction that was so universally expressed by those advertisers who favored us with their patronage in our previous extra numbers, gives us reason to expect a large representation in our April special.

Pietrowski's Perpetual Motor.

From the daily papers of the past month we have clipped the following scrap of arrant nonsense, which has been widely circulated:

"A motor which the inventor declares when once started, will run till it wears out.

"*New York, January* 29.—All day yesterday the small rooms of Albert Pietrowski, at 26 Spring-street, were crowded with visitors who had gone thither to see a new motor which had been advertised. Mr. Pietrowski is a Pole, an engineer by profession, and has been in this country sixteen years. He has devoted his leisure hours to the elaboration of his invention. The model that he exhibited consists of a pair of hollow metal wheels, four feet in diameter, which revolve on the same axis, but in opposite directions. The moving power is nine metal balls placed within the wheels so as to bear the rim down at first, and then gravitate toward the axis, where a side groove runs the balls off to a grooved radius of the wheel revolving in the opposite direction. Four balls were placed in the grooved radii of the first wheel and four in the radii of the second, and when momentum had been gained the ninth ball was added, to give additional power. To the axle of the wheels, which is also the axle of smaller grooved wheels that regulate the speed of the machinery, the shafting is applied. 'Give me a cast-iron wheel sixty feet in diameter,' said Mr. Pietrowski, 'and I will show you a motor of 300 horse-power that requires nothing to keep it in operation. It will continue to run until the material wears out.' Several of the engineers who witnessed the working of the machine, were sanguine in the opinion that for all practical purposes, leaving out the engine of the locomotive and the steamboat, it will be found of great value."

How any one gifted with common sense, and a knowledge of the elements of the theory of machinery, and especially any one laying claim to the title of "engineer," can be found to pronounce the above described mechanical toy "of great value," is beyond our comprehension. Here is a man, who, from the above account, proposes to set a pair of wheels in motion, and keep them moving by the gravitating action of a number of metal balls, so disposed within them as to run alternately from the rim of one wheel over to that of the other. He proposes to keep these balls in motion, in spite of the action of gravitation that must speedily bring them to rest, and to set the wheels in motion besides and keep them going. The whole story is so ridiculously childish that we cannot understand its appearance in a respectable newspaper, other than as a joke. It has not even the poor merit of being a puzzle. It is palpably either a practical joke, set up to test the credulity of the average newspaper reporter, or it is the outcome of the densest ignorance, and its originator is unworthy to unloose the lachets of Keely's shoes.

After which we are tempted to remark, that there is at least one *perpetual* feature about this perpetual motion business—and that is the astonishing persistency and regularity with which the crop of perpetual mo

tion inventors renews itself.* The utter fallacy of the idea of ever constructing a machine to work continuously with no new accessions of power from without—to perpetually regenerate its own power as rapidly as it is expended, has been exposed *ad nauseum;* but the error has so much vitality that no amount of heavy "sitting down on it" appears to affect it in the least. Like the fabled giant Antæus, who derived renewed vigor each time he was cast upon his mother Earth by Hercules, so every fresh exposure of this absurdity seems but to strengthen the infatuation of its victims. We venture to say there is scarcely one of our observant readers who cannot count among his acquaintances at least one representative of this genus.

Most frequently he is the unlettered mechanic, who despises books—that he cannot read—and book learning—that he cannot comprehend; and who, with a pertinacity worthy of a better cause, and which is only equalled by his ignorance, works away at his wonderful machine until in the fullness of time, the one is relegated to the junk-shop and himself to the poor-house. Sometimes he is the village "smarty"—the fledgling mechanic, wiser than his elders, in his own conceit, who illustrates how dangerous is a little knowledge, but to whom, happily, a few years of bitter experience, with their harvests of disappointment, may bring with them a modicum of wisdom for his salvation. And sometimes he is that arch-pest of society, the shameless charlatan, whose name is a synonym for impudence and effrontery, who speculates in popular credulity, fattens on ignorance, and laughs in his sleeve at his success in palming off his pinchbeck wares for true metal.

Most of us have seen them all at one time or another; we have pitied the blind infatuation of the first; we have regretted the foolish conceit of the second; and we have felt like applying the *argumentum ad hominum* to the last, with the boot of persuasion, for against every other form of deadly weapon, ancient or modern, he is invulnerable.

Mr. Henry V. Poor in the Role of a Protectionist.

During the past month a combined effort has been made by the agents of foreign rail manufacturers, before a committee of Congress, to secure a reduction of the duty on steel rails from $28 per ton (the present tariff) to $10 per ton; and prominent among the advocates of a measure to make our railways dependent upon foreign sources for their rail supplies, is Mr. Henry V. Poor, whose name will be familiar to most of our readers as the editor and publisher of a "Railway Manual," which has appeared for some years, and which is largely supported by the advertising patronage of American manufacturers of railway supplies, whose business Mr. Poor is now striving to injure or destroy.

That Mr. Poor is not actuated solely by patriotic motives in urging the passage of a measure which would inflict grevious injury upon American industry, appears from the fact that he figures in the advertising columns of one of the leading organs of free-trade in this country, and which is one of the strongest supporters of this infamous measure, as the sales agent of foreign rail makers, whose commission he is presumably anxious to handle, and whose interests he is not averse to advancing, since they are his own. Viewed from this standpoint, Mr. Poor is a "protectionist" of the most pronounced class; he urges that the American rail mills cannot possibly supply the immense demand for rails that will be required for the great extension of railway mileage unless recourse is had to foreign supplies, and that the only way to meet the difficulty will be to ignore our domestic industry altogether and put ourselves in the hands of foreign manufacturers, represented by himself. In this manner, Mr. Poor proposes to secure the greatest good to the greatest number, the latter being not our home manufacturers and their thousands of operatives—but number one.

But Mr. Poor does not tell the truth, as Mr. Swank and others who testified in opposition to the enemies of American industry before the Congressional committee clearly proved. The fact was palpably made evident that the capacity of the rail mills of this country was more than sufficient to meet all demands upon them for several years preceding the recent sudden revival of railway building. That the sudden and unexpected increase in the demand for railway material may have found our manufacturers unprepared to meet it at once, may be admitted without necessitating Mr. Poor's inference that the remedy for a temporary inconvenience, is to break down our home industries by lowering the protective tariff which called a number of the Bessemer works of this country into existence, and which, more than anything else, has been the potent factor in diminishing the cost of steel rails to our railways. That this is actually the case, is shown with the certainty of demonstration by a comparative statement of the prices paid by American railways for steel rails, from the period when the American Bessemer industry first came into into existence to the present time—a period of about 12 years:

	January, per ton.	December, per ton.
1868	$168 00	$145 00
1869	145 00	120 00
1870	115 00	105 00
1871	105 00	108 00
1872	100 00	125 00
1873	125 00	125 00
1874	123 80	80 00
1875	72 75	67 00
1876	70 00	54 00
1877	52 00	42 00
1878	44 00	44 50
1879	41 75	.....

When we were dependent on foreign manufacturers for our steel rails, the above tabulation shows that we paid fourfold for the luxury; and if experience is worth anything, it teaches the lesson that history repeats itself. We do not believe that Mr. Poor, with all his patriotism, can succeed in convincing the country that the proper way to promote domestic prosperity is to break down and destroy American industries and place ourselves at the mercy of foreigners—even if *he* is their agent.

Mr. Swank and Mr. Storrs, in their arguments and presentation of facts before the Congressional Committee of Ways and Means, showed, furthermore, that Mr. Poor's estimates of the probable immediate wants of the railways of the country in the item of rails, as well as his statement of the capacity of the American rail mills, were unreliable, and that he had greatly exaggerated the one and underrated the other, and both of these authorities presented facts to show that the present capacity of the existing works, and the carrying into effect of the enlargements now in progress at many of them, would be ample to meet the prospective demands of the railways of the country.

How Lightning-Rods Should be Put Up.

As an offset to the ridiculous pretensions of the Chambers Lightning Protection Company, which we have sufficiently ventilated in the columns of this journal, we add herewith the conclusion of Prof. Macomber's circular, of which the first portion, containing the opinions of a number of eminent men of science, (all of whom *endorsed* the Chambers rod as an unmitigated humbug), appeared in our issue of last month.

This portion of Prof. Macomber's circular gives the few plain common sense rules that should be adhered to in putting up a lightning-rod; and though it contains nothing new on the subject that has not already been presented to our readers in one form or another, we think it not amiss to print it as a part of the history of the Chambers humbug:

"I propose to give briefly in what follows the best method of putting up rods, as deduced from the answers to the questions of my circular, and from other authorities:

"*Size of Conductor.*—It should be ¾ to 1 inch in diameter, of solid iron. *The larger it is the better.* A bar of solid ½-inch square iron would be much better, however, than many of the rods put up. The form of the cross section is immaterial so long as the rod contains the requisite amount of metal, since the capacity of a rod to carry away a discharge, without melting, depends on the area of the cross section, and not on the surface. If copper is used, the rod need not be more than one-half or one-third as large as for iron.

"*Insulators of Glass.*—These are useless, if not harmful. Fasten the rod directly to the building with iron straps or staples. If there is a metallic roof or large masses of metal about the building, fasten the rod to them at their highest points. Fasten also to any large water pipes or gas mains in the building at the highest points. [At least one instance is recorded where gas pipes were ruptured by lightning, but it is doubtful whether the danger would not be equally great if no connection were made with such pipes. At any rate, all good authorities give directions as above.]

"*Ground Connection.*—This should be perfect. There is no question on this point. Damage from lightning, on buildings having rods, can generally be traced to a dry earth connection. If the rod simply sticks into dry earth a few feet, it is useless; better take it down. The manner in which rods are too frequently put up has brought disgrace on the name of science. Dig a trench deep enough to strike permanently moist earth; fasten a mass of old metal to the end of the rod, or surround it with powdered charcoal, cover up, and all will be well; or fasten to a large water main, always turning the rod away from the house. The usual method practiced, of simply driving the rod down straight into the earth from three to eight feet, has never been advocated by scientific men. A well is an excellent terminus for the rod. Let the upper end terminate in a point, not too sharp, and place one at each chimney, or ventilator, if a barn, making the rods 6 to 8 feet high, and near enough so that each rod will protect a diameter of four times its hight. Connect all rods together, and also solder to metallic eave trough which may be near them. If the point of the rod can be gilded, or tipped with copper or platinum, it would be well. All joints should be welded or fastened with close-fitting screws, and the whole covered with a coat of black paint. Make all metallic connections by means of strips of copper or copper wire. A continuous cable, made by twisting together from ten to twenty large fence wires, would make a good rod. At the top the wires may be spead apart and pointed—in fact, I am convinced that six common fence wires, twisted together, would make about as good a lightning-rod as those usually sold. Avoid making sharp turns with the rod.

"Statistics show that when properly put up, lightning rods do protect objects from the effects of the direct discharge. The damage to ships in the English navy used to be very great until Snow Harris put copper strips on the masts and fastened them to the copper bottoms of the vessels. Since then the damage from lightning has been merely nominal, and Mr. Harris was conferred the honor of knighthood and given an annuity of $1,500 for his services. For statistics on this question see Arago's Meteorology. Lightning rods are generally put up, not because the owner of the house has made up his mind to have one, but because some lightning rod peddler has made up his mind to sell him a rod. If rods are to be put up at all, let it be done on scientific principles."

*As if they had been made to order to verify this statement, the copy was scarcely in the printer's hands, when the editorial eye was caught by the following two items, that appeared in the daily papers of a week or two ago:

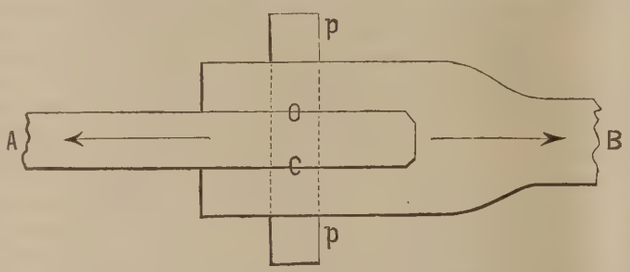
"Miss Hosmer, the American sculptress, whose 'Zenobia' created such a sensation amongst the artists some little while ago, has departed for Rome. She has given proof of her utter indifference to the advice and warning of wise men, as well as to scoffers, who seek to deter her from pursuing the object of her life, which is that of discovering the great secret of perpetual motion, and has taken a vast building and workshop in Westminster for the completion of her labors."

"*Marion, Ohio, February* 18.—William J. O'Bern, a miller, and William F. Hyett, a mechanic, of Rockland township, are reported to have discovered perpetual motion. They have sent a model to Washington and applied for a patent."

Shearing Strength of American Woods.

Mr. John C. Trautwine, a well-known authority in matters pertaining to engineering, communicates to the *Journal of the Franklin Institute* an account of some valuable practical experiments on the shearing strength of a number of kinds of native woods, to determine the reliability of this material for pins or tree-nails, for which it is very commonly employed.

For the purpose of these experiments, Mr. Trautwine employed the iron holder shown in the accompanying cut, (for which we are indebted to the *Journal*), through the cylindrical pole in which the wooden pin *p p* to be tested was placed. Two specimens of each kind of wood named in the annexed table were tested, all the specimens being of fairly seasoned wood, and free from defects. Where the differences in result did not exceed 10 per cent, the mean value is given.



The specimens tested were in the shape of cylindrical pins .64 of an inch (or full ⅝ inch) in diameter. The central pieces sheared off were ⅝ inch long. The single circular area of each pin was .322 of a square inch; and that of the two areas simultaneously sheared, .644 of a square inch.

The test specimens fitted closely into the cylindrical hole of the holder, and as the two parts A and B of the holder were pulled in opposite directions, the test pieces could only yield by direct shearing at O and C. The trials were made upon one of Riehle Brothers testing machines. To obtain the results in pounds per square inch of *total* sheared area, Mr. Trautwine has multiplied his experimental values by 1.55 (that is, .644 × 1.55 = 1 square inch).

SHEARING STRENGTH OF AMERICAN WOODS.

	Pounds per square inch.
Ash	6,280
Beech	5,223
Birch	5,595
Cedar, white	1,372 to 1,519
Cedar, Central American	3,410
Cherry	2,945
Chestnut	1,535
Dogwood	6,510
Ebony	7,750
Gum	5,890
Hemlock	2,750
Hickory	6,045 to 7,285
Locust	7,176
Maple	6,355
Oak, white	4,425
Oak, live	8,480
Pine, white	2,480
Pine, yellow, Northern	4,340
Pine, yellow, Southern	5,735
Pine, yellow, very resinous	5,053
Poplar	4,418
Spruce	3,255
Walnut, black	4,728
Walnut, common	2,830

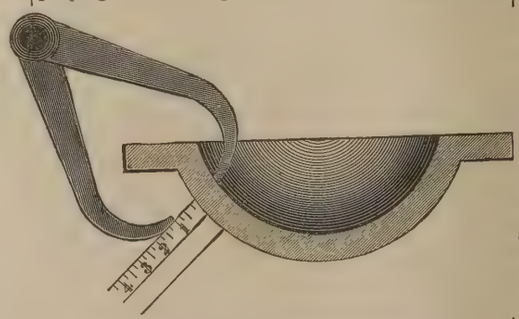
Lubricating Bearings.

It is impossible for a bearing to run cool until the high places are reduced so that there will be a uniform film of unguent between the two surfaces. It is a custom for purchasing agents, and in some cases for practical men, when ordering oil, to mention simply "lubricating oil," without specifying the kind of bearings for which it is to be used. The latter is a very essential point. Frequently, when the oil is received, it is found to give very poor satisfaction, and some of the bearings are found to run hot. Under these circumstances, the oil is generally charged with the fault, when, in reality, the fault has been in giving the order. A good lubricant for small, close-fitting, fast-running bearings must be of a very fine quality, and have a light body, in order to distribute itself between the close-fitting surfaces. Such a lubricant is entirely unfit for large bearings, where more body is required to carry the heavy weight which is placed upon them. It is the practice in most shops to use the same kind of lubricating oil for all the machinery, which, when properly considered, is both unreasonable and extravagant, for the reason that a bearing, when improperly lubricated, is worn away much faster than it would otherwise be, and on fine machinery the lost motion in the bearings requires frequent attention.

RULE FOR FINDING THE WEIGHT NECESSARY TO PUT ON A SAFETY VALVE LEVER, when the area of valve, pressure, etc., are known: Multiply the area of the valve by the pressure in pounds per square inch; multiply this product by the distance of the valve from the fulcrum; multiply the weight of the lever by one-half its length; then multiply the weight of the valve and stem by their distance from the fulcrum; add these last two products together, subtract their sum from the first product, and divide the remainder by the length of the lever; the quotient will be the *weight* required.

A Mechanical "Wrinkle."

To get at the dimensions of a piece of work of irregular shape, the following simple procedure is given by John Walker in the *Millstone*: The adjoined casting being of spherical form, with flange, it would puzzle most mechanics, without special tools, to find its thickness. The first thing usually resorted to would be to drill a hole at a designated point. The accompanying "wrinkle" provides a readier method, and



does away with the application of special tools. By simply applying a common rule, as shown, and setting the calliper to some even inch on the rule, so that it may easily be removed, it will be seen that the difference between the even inch denoted and the actual opening of the calliper is the dimension required.

Non-Inflammable Wood.

At a meeting of the British Association recently held at Sheffield, England, Colonel P. P. De la Sala exhibited non-inflammable wood for building purposes; also, wood shavings, non-inflammable, for the manufacture of mats, rope, etc. The inventor thus explains his peculiar method, which is already patented:

"Though all alkaline compounds reveal the property of rendering vegetable compounds more or less pliable and non-inflammable, I preferably make use of carbonates of fixed alkalies in the following way: I dissolve in cold or warm clear water carbonates of potash or soda, or I make use of them in a solution of filtered water heated to the boiling point, and add hydrate of lime to this solution, graduating the strength so as not to exceed a specific gravity of 1.060 if potash is used, or 1.050 when soda is used. In the first case, the strength of the solution corresponds to about 30 grains of hydrate of potash to the fluid ounce, or about 20 grains of hydrate of soda to the fluid ounce. Wood to be used in naval construction, and in buildings or structures of wood upon land, as well as vessels and land buildings already constructed, can be rendered fireproof by saturating the floors and decks, and all exposed woodwork, with alkaline lyes, and when dry, the wood may be whitewashed, painted, or varnished, in the usual way.

"For boards, planks, or thicker pieces of timber, I graduate the time of immersion so as to form a coating of from one-sixteenth to one-eighth of an inch, which can be obtained in from four to twelve hours, according to the more or less porous nature of the wood, or the compactness of its fiber. I consider a coating of about one-eighth inch deep to be a sufficient fire protection for all kinds of timber for building purposes, as the spread of fire and great conflagrations generally originate in relatively small causes, such as burning cinders, dropped sparks from fire-places, matches accidentally ignited, inflamed liquids, candles left burning, etc.; but the fire-proof coating can be made deeper, or even to go through the whole timber, in the event of its being considered desirable to combine great flexibility with absolute non-inflammability. In this case, I make use of hydraulic or other pressure, so as to force the alkaline lyes through the wood to the extent desired."

Referring to the above, the *American Exchange* says: "A comparison is yet to be made between this method and others as to relative cost of the flame prevention. *Per se*, any method of treatment whose cost exceeds that of fire-destruction in a given case, is practically inapplicable."

Palm Oil.

The principal source of the palm oil of commerce, used largely in the manufacture of soaps, perfumery, candles, and similar articles, is the west coast of Africa, south of the river Volta. Nearly 1,000,000 cwt., valued at $7,500,000, of this oil is annually exported to Great Britain. Among the natives it is highly valued both as an article of food (taking the place of butter), for lighting and cooking purposes, and for anointing the head and body. The so-called oil, which is rather a fatty substance, resembling butter in appearance, is obtained from the fruit of several species of palms, but especially from the one known botanically as *Elais guinensis*, which grows in great abundance on the western coast of Africa, and from which it takes its specific name. So thickly do these trees grow, and so regular and rapid are their supplies of fruit, that in some localities where the regular collection of the produce is not practiced, the ground becomes covered with a thick deposit of the oily, fatty matter, produced by the ripe berries. Deposits of palm oil, which may be almost called "mines" of "vegetable" fat, exist in some parts of the Gold Coast, and which, if not in themselves worth working, at least practically illustrate the natural wealth of the country in such productions, and indicate its undeveloped resources. These "mines" would not probably repay the cost of exploration, as the palm oil is apt to become rancid and valueless for its general uses after long exposure, though for such purposes as candle-making these deposits might still be valuable.

RULE FOR FINDING THE PRESSURE PER SQUARE INCH ON SAFETY VALVES, when the area of the valve, weight of ball, etc., are known: Multiply the weight of the ball by the length of the lever, and then multiply the weight of the lever by ½ its length; then multiply the weight of the valve and stem by their distance from the fulcrum; add these three products together; this sum, divided by the product of the area of the valve, and its distance from the fulcrum, will give the pressure in pounds, per square inch.

Improved Ventilator and Chimney Cap.

In former issues of this journal we have had occasion to refer to the system of constructing glass domes for skylights adopted by Messrs. S. J. Pardessus & Co., of 9 and 11 Park Place, New York, [see Vol. X., p. 174, and Vol. XI., p. 105], and in the following we invite attention to some novel and useful designs for dome exhaust ventilators and chimney caps, manufactured by the same firm.

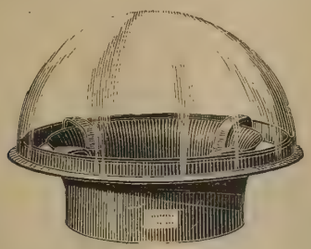


Fig. 1.—Glass Top.

We herewith present a few engravings showing several modifications of the device, and the different methods of applying it. In general terms, the apparatus consists of a dome-shaped top or cap of glass or metal, resting upon a flanged metallic rim or base piece, the whole being held in place over a ventilating tube, which extends upward partly within the dome, by means of simple metal straps or bands. The action of the wind upon the surface of the dome, no matter from what direction it may come, will be that of an exhaust, tending to draw the air from the ventilator, and consequently out of the apartment with which the device is connected.

The form of this ventilating device—as will be understood from an inspection of the annexed engravings—is such as to exclude rain, snow, and dust from the apartment or building to be ventilated, while it utilizes the force of the wind from whatever direction it may come, to exhaust the fouled or vitiated air therefrom. The amount of the ventilation can be controlled by opening or closing a damper attached to the apparatus; and where the particular situation in which it is applied requires it, the ventilator is placed upon an elbow, which can be turned and adjusted at any angle. It is therefore claimed to be a valuable adjunct to the sanitation of buildings, public and private, railway cars, etc., as a corrective of bad ventilation, faulty chimney flues, and other troubles connected with the healthful supply of air.

Fig. 3,—Application of the Dome Ventilator Cap in Various Positions.

Fig. 1 shows the dome ventilator, with glass top, adapted for situations where it is desirable to secure effective ventilation with the maximum of light, as, for example, in skylights, window-lights of dwellings, school-rooms, offices, etc. These caps of glass are made in hemispheres of from 4 to 25 inches diameter to suit vent pipes, or openings from 2 to 15 inches diameter. The metal-top dome, applicable to a wider range of uses, is shown in Fig. 2. It is adapted for window-lights in school-rooms, offices, dwellings, and smoking-rooms; as large ventilators over audience halls, public buildings, ice-houses, breweries, etc.; for ventilating railway carriages, for smoke pipes, also over lamps, sewer or closet pipes, vessels, chimney flues, or any situation where pure air is required, without exposing the inmates of house or apartment to the liability of taking cold from drafts, or on flues to be remedied.

In the application of the dome ventilator cap to railway cars, or other moving structures, particularly to the sides of a car transom, the use of a reversible elbow permits the apex of the dome to be set in the direction of its movement, producing a strong current over the exterior of the cap, giving great activity to the exhaust, and speedy removal of the confined air.

Fig. 3 exhibits the dome ventilator cap in various positions, illustrating the different situations in which it may be advantageously employed. A, shows one of the larger sized ventilators for ventilating entire buildings, such as school-houses, theaters, churches, breweries, etc. They are furnished by the manufacturers, of galvanized iron, and of any size cap and diameter required. B—With metal top, as a cellar or sewer ventilator, issuing at the apex of the finial, the gable, or any other convenient place in the roof, so as to be above all the windows. C—With metal top, as a chimney flue cap for factories, dwellings, and smoke pipes, preventing downward currents, and damaging influences arising from defective conditions of flues. D—With a brass, nickel-plated, galvanized iron, or glass cap, as an apartment ventilator, fixed in a light of glass; noiseless, because immovable, always working, unless the self-opening damper within is intentionally closed. E, finally, exhibits the device in the shape of a galvanized cap, attached to an adjustable or a bayonet-slot elbow, at any desired angle; adapted to be applied as a kitchen, laundry, or closet ventilator. It is also shown at F, arranged on a pipe issuing from the wall.

Further details in regard to these sanitary appliances may be obtained by addressing the manufacturers.

The Moss Industry of Louisiana.

The Louisiana moss industry, says the New Orleans *Times*, is one of the important industries of New Orleans, and as such demands some attention at the hands of the press. In common with all Southern manufacturing interests, it has had its days of prosperity and its days of gloom in business. At present, however, the depression seems about over, and the trade is attaining its former respectable proportions.

The history of the manipulation of moss is very simple. It is gathered mostly by negroes, who devote a spare hour of the day to such work. After a tree is stripped it is allowed to rest for seven years, during which period of time the moss renews itself. Cypress moss is preferred, as it is the longest and most tenacious of all the varieties. After the moss is gathered it is placed on a sunny spot, and left a month to the action of wind and weather. At the end of that time the grayish bark peels off, leaving the hair almost clean. Some of the moss requires no manipulation, while other assortments are, in weight, more than half dirt. After being thus dried, the material is sold to the plantation storekeeper or to the cross-roads gro-

Fig. 2.—Metal Top.

cery-man, and the gatherer receives from one to two cents a pound for it, according to its quality. The stuff is baled and brought to the city for manufacture. The gatherers of late have seemed surprised at the falling off in the prices paid for moss. The reason is simple. The demand is not great, or, rather, has not been, up to within the last three months, and the quality of moss gathered has not been of a good grade. The gatherers seem to think that dusty and rotten moss should command three cents, and be worth in the market four and a half cents, because it took as much time to gather it as it does to gather moss that commands such prices. If they would bring in a better article they would have no reason to complain of the smallness of the prices paid.

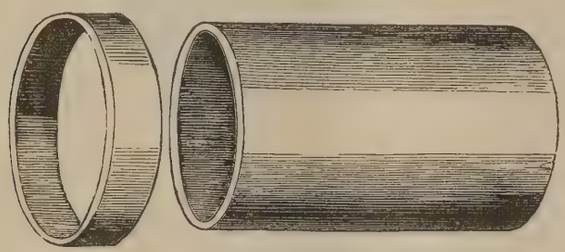
After the moss reaches the factory it is subjected to the action of the washer, which is a large cylindrical arrangement with a wheel inside, which pulls the moss hither and thither, and dashes it through a vat of boiling water and soap, until the material is cleaned; then it is hung out upon racks to dry. This done, it is put into the duster, a fan mill, which entirely removes all the dust that may have survived the washing process. As a result, the moss comes into the factory yellow in color and goes out inky black.

The article is then made up into bales according to quality, and lettered with single, double, treble, and quadruple X's. The highest grade (XXXX) can hardly be distinguished from the finest and choicest horse hair. The other grades are consumed mostly in Louisiana.

More About Color Blindness.—Dr. Keyser, who has spent eight months in examining train employees of railroads that center in Philadelphia, finds color blindness in 3½ per cent of the whole number so marked that they were unable to distinguish one color from another, while 8½ per cent, although able to tell colors, were unable to distinguish shades, and were thus rendered incapable of performing duties required of railroad men. Two of the color-blind men had educated themselves to know that red is a bright, intense color as distinguished from green, which they described as dull. But when light green was put before them, they called it red. They explained that the green light had at times shown red to them, and they had stopped the trains. But suppose the red had shown green!

Impervious Sewer Pipes.

The average city sewer is so crudely and carelessly thrown together, that it is really a question of some difficulty to decide, now and then, whether it is really a sewer or a drain. The average city sewer, in fact, frequently embodies in its construction the very principle which should be the distinguishing mark of a drain, as contrasted with a sewer, and this fact may explain why, in popular parlance, the names of "sewer" and "drain" are indifferently applied to the same thing. A drain, properly speaking, is intended to receive fluids throughout its entire length, and, if possible, throughout its entire surface; and for this reason it is



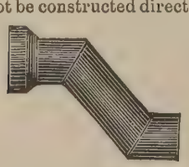
Pipe and Ring.

constructed either of loose stones piled in a trench, or of parallel logs similarly placed, or of pipes having lateral or longitudinal fissures and porous walls for the special purpose of permitting and facilitating percolation.

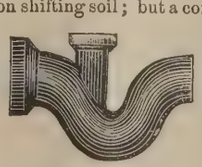
The function of a sewer, on the other hand, is to carry off fluids more or less offensive and noxious, in order to prevent their percolation into, and saturation of, the soil. For this reason it should have neither fissures nor pores, which would permit percolation, and all inlets leading into it should be so trapped as to prevent any of its contents from obtaining exit, except at the designated place of discharge.

An impervious drain is an absurdity—a pervious sewer is worse than an absurdity, since it is positively dangerous in permitting the foul refuse it should carry off, to saturate the soil and breed contagious diseases. It would be impugning the intelligence of our readers to enter into a disquisition on the importance of proper sewerage to cities and towns, and we shall therefore simply devote a few paragraphs to defining the general principles that should guide the construction of sewers.

A sewer should be so constructed, that each day's influx should be promptly passed out, either by natural flow or by flushing, and not allowed to deposit sediment and so gradually clog up the line, or to ferment, putrefy and breed disease. There must be provided for this purpose sufficient descent or fall; the alignment, especially that of the bottom, should be good. The descent should be uniform, the interior surface smooth, so as to reduce friction, and not to cause or favor clogging; the walls should be *absolutely impervious;* and the section such as will cause the most rapid possible flow with the minimum quantity of sewage. To maintain the alignment, the sewer line should not be constructed directly upon shifting soil; but a con-



Half Trap.



Hand-Hole Trap.

crete or other substantial foundation should be provided to prevent the vertical displacement or giving way of the line. Rapid flow being highly desirable, the interior walls of the sewer should be smooth; mortar projecting from the joints of a brick sewer, notably impedes the flow, and even wholly arrests the putrescible matter.

As to bricks—the employment of this material in the construction of sewers, necessitates a much larger pipe than if the walls were smooth and in line; not only because of the natural roughness of the bricks and of the projecting mortar, but also because pockets are formed here and there by reason of the sinking of individual bricks, or traps are made by their projecting beyond the regular wall surface.

We are not interested here specially with the form of sewers, and will therefore pass this point with the remark that a flat-bottomed sewer is the worst form that can be devised as regards velocity of flow; the circular bottom is better, while the egg-shaped section, with the point down, permits of the minimum current flushing and scouring out the bottom.

In the foregoing remarks, we think it has been made reasonably clear that a sewer line constructed of bricks, no matter how well put together, will not realize in practice, save for a very limited period, the requirements which an intelligent knowledge of the sanitary elements involved in the removal of sewage show to be necessary. No brick-work can be made to *remain* impervious under such conditions. The mortar used in the joints, constantly moist, must sooner or later succomb to the disintegrating and decomposing action of the material passed through it, and the whole line will gradually pass into the condition of a sieve, permitting the liquid portion of the sewage to percolate through it, to saturate the adjacent soil, while the solid portions will be held back. Thus, several grave evils are called into existence. The impregnation of the soil with such organic refuse is one of the fruitful causes of that class of infectious diseases, which, from their origin, are very properly called "filth diseases," and which figure prominently in the mortuary records of every large city and town; and the capacity of the sewer is gradually diminished by the accumulation therein of the solid portions of the refuse, thus intensifying the trouble first named.

In no other way can these evils be obviated save by

Slant.

Socket Pipe.

dispensing entirely with brick sewers, and by constructing these important structures of vitrified clay, or some other analagous material like this, that shall be free from the objectionable features that appear to be inseparable to the use of bricks for the purpose. The improvements that have been made in the manufacture of this class of materials, have been such as to fully meet every requirement, both as to excellence and adaptability, and economy, for the purpose intended.

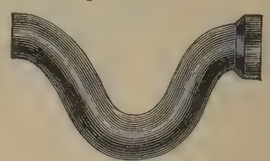
There are three varieties of pipes manufactured for this purpose, known respectively as salt-glazed vitrified clay pipe; slip-glazed pipe; and cement pipe. The latter, however, does not exactly meet the requirements that we have laid down above, and may therefore be omitted from the special considerations that follow.

Salt-glazed and slip-glazed wares are the names which designate the products with which we are here concerned. The salt-glazed wares are made by Western manufacturers, prominent among whom must be named the immense establishment of the Akron Sewer Pipe Company, of Akron, Ohio; while the slip-glazed wares are represented generally by the Eastern manufacturers, (the salt-glazing, it may be added, is still almost universally employed abroad). In producing the salt-glaze, a quantity of salt is thrown into the kiln at the proper time, the vapors of which produce a vitreous coating on the surfaces of the pipes exposed to their action. The slip glazing is accomplished differently, and consists in dipping the unburnt pipes into a mixture of so-called "slip clay" (or Albany earth) and water—a species of clay carrying carbonate of lime and alkalies—to the fluxing of which, at the high heat of the kiln, the subsequent glazing is due.

As may be supposed, from the active rivalry between the manufacturers of these products, there has been much discussion on the question of the relative merits of these two representative processes. The Akron Sewer Pipe Co., of Akron, Ohio, the largest establishment of its kind in the country, is, as above remarked, an unqualified advocate of the superiority of the "salt-glazed wares" over all others.* Referring to their wares, they claim that they are in every respect equal to the salt-glazed Scotch pipe—which has a high reputation for durability—and that their Akron wares have shown themselves to be superior to the Scotch in different competitive tests.

We can do no better in a description of this class of

Sink Pipe.



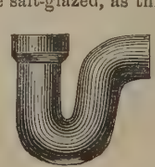
Running Trap.

products, than to present its merits and advantages from the standpoint of its representative manufacturers—the Akron Company aforesaid: "Salt-glazed clay pipe is made of a clay, which, when subjected to an intense heat, becomes vitreous or glass-like, and is glazed by the vapors of salt, the salt being thrown into the kiln, creating a vapor which unites chemically with the clay and forms a glazing which will not scale or wear off, and is impervious to the action of acids, gases or steam; it unites with the clay in such a manner as to form part of the body of the pipe, and is therefore indestructible."

"Salt-glazed pipe," the same makers affirm, "can only be made from clay that will vitrify—that is, a clay which, when subjected to a high heat, will become a hard, compact body—not porous." And they add to this that "slip-glazing is only resorted to when the clays are of such a nature that they will not vitrify, but remain an open, porous substance." On this point they quote the following comments, on the authority of Col. Waring, the well-known sanitary engineer; to wit:

"Any roughness of surface, as in even the best made cement pipes, tends to catch hair and lint, and thus to form nuclei for accumulating obstructions, sometimes so hard they can be removed only by forcible, mechanical means. . . . The material of the pipe should be a hard, vitreous substance—not porous, since this would lead to the absorption of the impure contents of the drain; would have less actual strength to resist pressure; would be more affected by frost or by the formation of crystals in connection with certain chemical combinations, or would be susceptible to the chemical action of the constituents of the sewage. . . . Much experience with cement sewer pipe seems to demonstrate that they are not sufficiently uniform in quality, nor sufficiently strong and durable, to be used with confidence in any important work, whether public or private. Sewer pipes should be salt-glazed, as this re-

Elbow.



P Trap.

quires them to be subjected to a much more intense

* In support of the comparative superiority of "salt-glazed" over "slip-glazed" wares, the Akron Company vouches for following statement respecting the recent alleged failure of clay pipes reported by the New York *Herald.* That journal based its assertion upon the fact that certain clay pipes—length of service not given—when taken up, were found to be badly decayed. The Akron Company affirms, respecting this case, that investigation disclosed the fact that the decayed section in question was a "slip-glazed" pipe—or what is commonly known in the East as terra-cotta drain pipe; while salt-glazed Scotch pipe, that had been down as long as that which had decayed, was in a state of perfect preservation.

heat than is needed for 'slip' glazing, and thus secures a harder material."

The following is a tabulation of the results of some competitive tests, of different kinds of pipe made and published in Boston, by W. H. Bradley, Superintendent of Sewers. The following were the conditions of the tests: The pipes were 3 feet long and without sockets, except as noted. The crushing test was made by bedding the pipes horizontally half their depth in sand, and crushing them by a weight applied uniformly along the length, on the top. Figures are pounds per foot of length, (average of three pipes). The breaking test was made by supporting ends of pipes on two blocks, 2½ feet apart, and applying weight at center. Figures are total weight, (one test). The abrasion test was made by applying a section half an inch square, loaded with 20 pounds, to a revolving grindstone 3 feet in diameter, kept wet and clean. Figures are revolutions necessary—1st, to remove glazing; 2d, to grind away one-10th of total thickness, including glazing (average of two tests).

The comparison between the Standard Akron Salt-Glazed, the Scotch, the best Slip-Glazed, and the best Cement Pipe, is exhibited in the following table, which we give on the authority of the Akron Sewer Pipe Company:

KINDS OF PIPE.		Weight, lbs. per ft.	Thickness, inches.	Specific Gravity.	Crushing Weight, lbs. per ft., Length.	Breaking Weight, lbs. on 2 ft. 6 ins. space.	Abrasion: Glazing	Abrasion: 1-10 thickness.	COLOR OF FRACTURE, AND REMARKS.
D. L. King, Secretary Akron Co., Ohio	(Eastern Slip Glazed Clays)	40	0.99	2.29	2236	3853	37	200	Dark Red.
Wm. Nelson, Jr., New York, Scotch J. B.		43	1.12	2.19	1875	3982	9	32	Light Red.
R. G. Walmsly, New York, Scotch R. B. S.		44	1.22	2.07	2458	4903	22	75	Light Red.
J. Edmond & Co., Boston, Scotch		45	1.19	2.10	2244	3368	12	29	Slate Brown
Portland Stoneware Co.		37	1.02	2.06	2140	3613	10	35	Yellow White.
G. W. Rader, New York		41	1.11	2.07	1510	3675	7	15	Reddish White.
T. W. Carter & Co., Boston		41	1.10	....	2144	4597	8	17	Reddish White.
Salamander Co., Woodbridge, N. J.		43	1.10	2.19	1606	3870	8	17	Reddish White.
O. O. Bowman & Co., Woodbridge, N. J.		42	1.16	2.03	1438	4903	10	42	Slate
R. G. Walmsley, Agent Jefferson Co., Ohio		41	1.07	2.18	2070	....	15	34	Reddish yel., 2 ft. length.
Edmands & Co., Charlestown		36	0.95	2.00	1905	....	13	32	Yellow White, 2 ft. length.
F. B. Day, Boston, Portland Cement (round)		67	1.62	2.19	2640	5211	..	...	Light Gray, Sock Joints.
F. B. Day, Boston, Portland Cement (flat bottom)		76	1.58	2.19	2919	....	..	199	6 months old, Sock Joints.
Lewis & Willett, Boston, Portland Cement (flat bottom)		68	1.50	2.21	2940	....	..	154	One year old, 2 ft. length.
Lewis & Willett, Boston, American Cement (flat bottom)		64	1.60	....	2424	....	..	37	2 ft. length, 5 months old.

In a set of test trials made at Washington, in which a comparison was instituted between the best Scotch and the Akron Salt-Glazed, we are told "the Scotch pipe crushed into small pieces under a suspended weight of 600 pounds. The Akron pipe split like barrel staves under a suspended weight of 700 pounds. At Chicago, a test, made in 1869 by Mr. W. H. Clark, Assistant City Engineer, was on several specimens of vitrified clay pipe from different manufacturers, and was by hydrostatic internal pressure; the Akron pipe was pronounced the strongest exhibited."

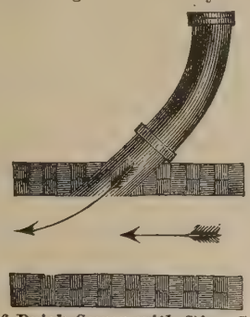
We have already extended our article beyond the limits we ordinarily allow, and must defer an account of the special methods of manufacture pursued by the Akron Company, for a future issue, contenting ourselves at present by briefly calling attention to the accompanying illustrations, which represent the principal styles of product manufactured at their works.

Railroad Extension in the United States.

A glance at the statistics of railroad construction in this country during the past year, affords some instructive information. The *Railroad Gazette*, a very reliable authority on the subjects with which it deals, gives the following comparative table showing the number of miles of railroad built in the country for a series of years. These figures alone afford an accurate indication of the condition of the general business of the country. The year 1873, for example, the last half of which precipitated the recent financial panic, shows a notable falling off from the figures of the prosperous year preceding it. The figures of 1874 and 1875 grow progressively smaller; a barely perceptible advance is made in 1876, 1877 and 1878, as the general business of the country is slowly recovering; but in 1879 they take a sudden upward swing—in sympathy with the revival of business, viz.:

Year.	Miles.	Year.	Miles.
1872	7,340	1876	2,460
1873	3,883	1877	2,301
1874	2,025	1878	2,916
1875	1,561	1879	4,430

Other facts relating to the railways of the country



Section of Brick Sewer with Pipe Connection.

will be found of interest—for example: The total mileage of the railroads of the United States at the close of 1878, was reported in "Poor's Manual" as 81,841; adding to this the number of miles constructed in 1879, (i. e., 4,430), we have the grand total of 86,263 miles of railroad in the United States at the beginning of the present year.

Estimating our population at 49,500,000, the above figures would give the ratio of 1 mile of railroad to every 574 persons. As the European average is 1 mile of railroad to (about) 3,300 persons, it will be seen that

T Branch.

Y Branch.

the extension of the railroad system in this country is vastly greater in proportion to its population than in Europe. This notable difference does not, however, imply that railroads in this country have been unduly

Curve.

and unnecessarily extended, since the great extent of the United States, the diffusion of our population over vast areas, and the nature of the bulk of the products transported over the roads, demand vastly more extensive facilities for the distribution of commodities to our scattered markets, than in the densely populated and comparatively compact states of Europe.

On these and other accounts, it is confidently anticipated that the ratio of railroad mileage to population, great as it now appears, will be considerably increased in the near future, to meet the actual and prospective wants of the country in the great agricultural regions of the West and Northwest. It is this region that appropriated 3,200 miles of the new railroads built in 1879, or almost exactly three-fourths of the entire mileage; and it is this region that will most probably receive an immense accession to its railroad mileage during the next few years.

A comparison of the mileage of this section of the country with the Eastern and Southern sections, will show how far this inference is justified. The Southern States—those south of the Potomac and Ohio, and east of the Mississippi rivers (including Louisiana)—built last year only 496 miles, about 11 per cent of the total mileage constructed; the six New England States built only 40 miles, less than 1 per cent; and the Middle States only 137 miles, (about 4 per cent); while the other 84 per cent is credited to the rapidly growing West and Northwest.

Millers' International Exhibition.

An international exhibition of machinery and appliances used in milling, is announced to be held in Cincinnati, O., commencing on May 31, 1880, and to be continued until June 26th, under the auspices of the National Millers' Association.

From the elaborate preparations that have been made for it, the coming event promises to be the most important and interesting of its kind that has ever taken place in this country, and a large participation of American and foreign exhibitors is assured. A bill providing for the admission, duty free, of all goods and machinery of foreign manufacture intended for the exhibition, has passed the National House of Representatives, and will doubtless be equally favored by the Senate and receive the approval of the President.

One of the features of the forthcoming exhibition, that promises results of much practical value, will be a test trial of automatic cut-off engines, for which elaborate preparations have been made. These tests will be conducted under the immediate personal supervision of Mr. John W. Hill, C.E., who has prepared an elaborate code of regulations for the conduct of the trials. Every assurance has been given that could be desired, that these trials will be conducted with thoroughness and impartiality, and a number of the most famous American engine builders have signified their intention to participate in the competition. These trials will no doubt afford much valuable information concerning the most recent advances in the construction of steam engines, and at the proper time we hope to lay the substance of this information before our readers.

The Hudson River Tunnel.

The work upon this enterprise, to which we have several times made reference, is being steadily pushed forward, and public interest is again attracted to it, especially from the announcement of a change in the plans of its engineers. The original design contemplated a single tunnel-way under the river, having a nearly circular section; but during the past month the tunnel company decided to change their plans, and to bore two smaller tunnels adjoining and touching each other, instead of the larger single passage previously decided on.

The reasons for this change of plan that are given, are that two smaller tunnels can be bored with greater economy than one large one—a statement which, while it may hold good under certain circumstances, and in the case here under consideration, would be hazardous to pin one's faith to as a universal proposition; and that two such tunnels of smaller dimensions—15 feet diameter in the clear—will be stronger than the larger one (24 × 26 feet) originally proposed. The two tunnel-ways will meet and overlap about a foot. It is affirmed that this change of plan will enable the work to be completed somewhat sooner than has hitherto been anticipated.

"Electricity as an Anti-Incrustator in Steam Boilers."—The conclusion of this article has been crowded out for the present by press of other matter.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

John Jacob Astor has given a plot of land 100 feet by 52½ on Lafayette place, adjoining the Astor Library, to the trustees of that institution to enable them to build an extension to the building. Work on the addition has already been commenced.

Thomas Bruns, the builder, has just finished, on the north side of Ninety-fifth street, between Lexington and Third avenues, a row of six houses, each 16.8x50 x102. They are all of heavy brown stone and contain three stories and a basement.

Richard Arnold and Henrietta Constable have filed plans with the Department of Buildings for a brick and stone-trimmed store, 71 feet 6 inches by 120 by 184 feet, 6 stories high, to be erected at 33, 35 and 37 East 17th street. The cost is to be $200,000. The building is to be fire-proof and to have mansard roof.

The Union League Club-house, Fifth avenue and Thirty-ninth street, is built up to the top of the mezzanine story over the first story; the work is so far advanced that some idea can formed of the style and general appearance of the building, when it will have been completed. The materials used are pressed brick with brown-stone trimmings.

Since the 1st of January a marked increase in the applications for building permits is noticed. Among the most important applications filed are those for a large building on the southwest corner of Broadway and Forty-first street, the cost of which is to be $85,000, and a first-class store on Broadway, for Ward & Bradhurst, at a cost of $75,000.

The Board of Education has decided upon engaging the services of a supervising architect, whose duty it shall be to supervise the construction of all buildings connected with the public schools of the city, to see that they are safely and properly constructed, provided with proper means for securing ventilation, and generally to make sure that such buildings are made comfortable, healthy, safe and convenient. If this office is assigned to a competent architect, with power to enforce his criticisms, the decision of the Board will accomplish much good.

A large force of workmen under Morton & Cheesley, contractors of Boston, are busily at work on the Metropolitan Concert Garden, corner of Broadway and Forty-first street. The plans are from the office of George B. Post, architect, and will be a credit to the architecture of the city. The structure is to be two stories high, with mansard roof. A part of the roof will be covered with awnings, and form a pleasant summer garden. The building will have a frontage on Broadway of 92 feet, and will extend back 158 feet on Forty-first street. The cost of the building will be about $85,000.

The *Sanitary Engineer* lately offered prizes in competition for the best plans for a public school-house in this city. The report of the Committee of Award, which consisted of George B. Post, John S. Billings, John D. Philbrick, William R. Ware and C. R. Agnew, has been completed. The prizes have been awarded as follows: The first prize of $250 to Arthur T. Matthews, Oakland, Cal.; the second of $125 to Samuel F. Thayer, Boston; the third of $75 to H. C. Kock & Co., Milwaukee, while the fourth of $50 is given to R. G. Kennedy, Philadelphia. The other successful competitors are H. E. Siter, Boston; F. C. Merry, New York; Frederick Baumann, Chicago; W. P. Wentworth, Boston; Clarence S. Luce, Boston; J. Appleton Wilson, Baltimore.

The committee in its report declares that none of the plans submitted fulfill the requirements of a sanitary school building. It recommends certain qualifications requisite to a public school building in a large city. The most essential of these is light and the conditions imposed in this competition made it impossible to secure sufficient light. Most of the plans submitted were rejected by the committee for defects in this particular. Many of these plans would make excellent school buildings if placed in a sufficiently clear space. The committee did not, therefore, recommend the plans to which awards have been made as being the best designs for a school building except under the conditions which seemed to have governed the building of school houses in New York.

The new Madison Square Theater, recently opened to the public, seems to have been built with strict regard to every modern improvement that could be brought into requisition to insure absolute safety, comfort, and convenience. All the floors and stairways of the vestibules have been constructed solely of iron and marble. These vestibules are of sufficient size to contain the entire audience, and there are three exits from each floor of the auditorium. The floor underneath the parquette is made entirely of iron and brick filled in with concrete, rendering it absolutely impossible for the theater to take fire from the basement. The orchestra circle is supported upon iron pillars and anchored to the side walls, which are two feet thick, with the strongest beams. The upper balcony is anchored to the same walls by beams and trusses capable of bearing many times the weight that can in any way be crowded upon them. The auditorium is separated from the stage by a thick brick wall, and the stage opening is so far below the ceiling that even if the stage apparatus were to take fire it would be a very long time before even the smoke of the fire could enter the auditorium. In addition to this, by a very simple contrivance of water-pipes placed behind the proscenium arch, the whole stage could be drenched with water in less than thirty seconds. The carpenter shops and dressing-rooms are separated from the theater by a solid brick wall three feet in thickness. The exits from the theater are three in number—from both balconies and the parquette. A careful study of the best treatises on the subject proved that it would require one million cubic feet of air per hour to supply the audience with a perfectly fresh and wholesome atmosphere. This amount of purified and fresh air is driven into the house through numerous pipes, so distributed that the air enters the house without the least draught or annoyance of any kind to the audience. The air is drawn by a powerful steam ventilating apparatus through an immense shaft from the roof of the house. In winter this air is tempered by being driven over steam radiators in the basement, and then distributed through nearly four hundred separate pipes, that enter the auditorium through the floor and from the front of the stage. In summer this air is passed over ice and driven through enormous flues in the side walls, from whence it falls through a number of small apertures under the balconies into the auditorium, keeping the temperature of the house as fresh and cool as in winter.

Jackson S. Schultz, Robert M. Strebeigh, and T. F. Thomas, executors of the estate of the late Abner Chichester, have made an attempt to solve the tenement problem in the densely populated district near the Grand street ferry. The material of the tenement, which is called the "Monroe," is brick, with red mortar, and there is little attempt at ornamentation, but the irregularities in the exterior of the front, each showing plainly its purpose, and an octagonal tower on the corner make it one of the most attractive buildings on the east side. The front extends eighty-eight feet on Monroe street, and one end extends seventy feet on Corlears street. The principal fire-escape is the main stairway, from which no doorway opens except out doors on to stone and iron balconies. A person desirous of entering any apartment in the building above the ground story must ascend this circular stairway to the balcony of the story in which the apartments are. The steps are of slate, the hand rail is of galvanized iron, and the sides are of brick, painted in cheerful colors. There is no woodwork in the stairway, and the circular brick wall that separates it from the rest of the building is over a foot thick in its thinnest part. The balconies, which for all purposes of safety are out doors, extend eighteen feet from the staircase tower half way to each end of the building. The building at its ends, like the staircase tower at the center, juts out even with the balconies, so that they appear strong and safe. No doors of apartments open upon the balconies. This was a sacrifice made in the interest of light. The space was needed for windows. There is no room in the house—kitchen, bed-room or parlor—without its window. Each of the five stories is eight feet and three inches between floor and ceiling, and the arrangement of rooms is the same in each. The floors contain material to deaden the sound, and the partitions between each suite of apartments are similarly filled in. The balconies are three feet four inches wide. Passing into the main hall of the eastern end of the building, the visitor, after walking about fifteen feet, comes to a place where, within several feet of each other, he finds the entrances to several suites of apartments. There is a similar hall in the north end of the building, but as there is an L extending along Corlears street, this hall is nearly forty feet long. In addition to the above-mentioned conveniences exclusively reserved to the occupants of each compartment, each family will have a wood and coal closet in the cellar, to which it alone will hold the key. The following is a description of a four-room suite, renting from $3.60 to $4, according to the story in which it is found. Private hall; two rooms of ten feet nine inches by 16 feet eight inches; one room ten feet by seventeen feet six inches; one room eight feet by sixteen feet. In each of these rooms there is one window. There are besides two washrooms in this suite, each of which contains two windows. Each of the four principal rooms, except the smallest one, has a closet and one of them has two closets. The depth of the building, except at the ends and where the staircase is located in the center of the front, is only thirty-eight feet and eight inches. The cost of the building has been $30,000, and the ground on which it stands is valued at $7,000. William Field & Son were the architects. The first story is fitted up for stores.

Miscellaneous.

A new $70,000 court-house is to be built at Shelbyville, Ill., from the plans of Mr. Plaisted, a Chicago architect.

The bill appropriating $250,000 for a public building in Toledo, Ohio, has been approved by the House Committee of Congress on Public Buildings and Grounds.

The Little Miami and Louisville Short Line Railroad Companies, at Cincinnati, will unite in building a huge new passenger depot at the southeast corner of Pearl and Butler streets. It is understood that work upon the structure will begin at once.

The Nicholson File Company, at Providence, R. I., is making extensive improvements at its works in that city. The additions are a new hardening room, packing room and a two story building, which is to contain the offices of the company. The materials used are brick and stone.

Competitive designs are now being made in Philadelphia for a large building for the Union Insurance Company, at the corner of Third and Walnut streets, in that city. This building will be 50 by 78 feet, brick and marble, four stories high. The cost, with the ground, will be about $115,000.

A unanimous report has been made to the House of Representatives by the Committee on Public Buildings and Grounds, in favor of appropriating $600,000 for the erection of a government building in Brooklyn. This has been indorsed by the Secretary of the Treasury and the supervising architect.

Geo. Armor, of the firm of Armor, Dole & Co., grain dealers, Chicago, is putting up a large block of stores on the corner of Adams and Franklin streets, in that city. Furst & Rudolph are the architects. The block will be built of stone throughout, cornice of stone, except upper member, to be of galvanized iron. Cost, about $160,000.

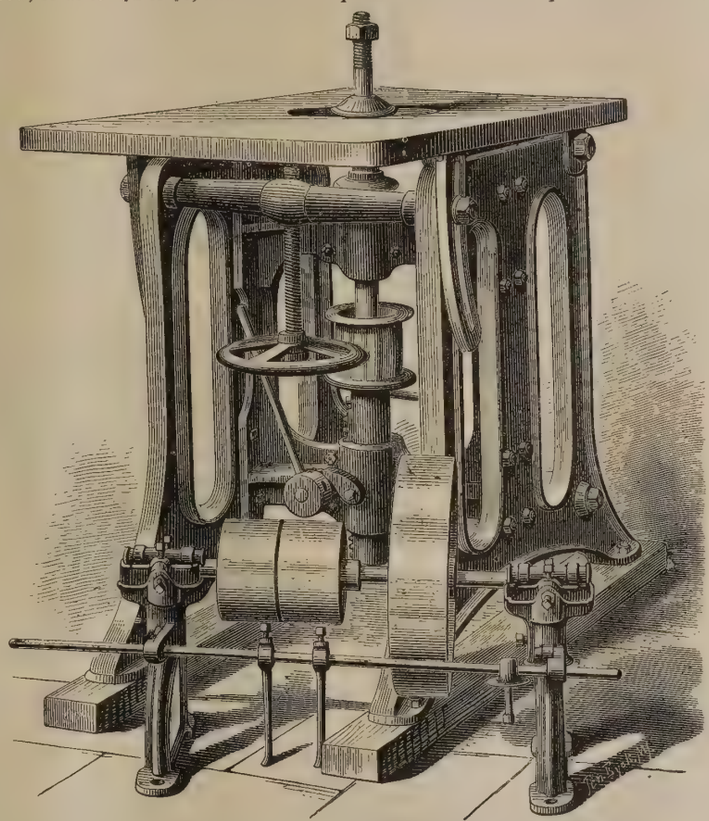
Stove-Plate Machine.

The machine shown in the adjoined engraving illustrates a special application of the emery wheel to do away with a large amount of tedious work formerly done entirely by hand with cold-chisel and file. This work the machine performs expeditiously and well. It is so designed that the castings to be dressed may be readily adjusted at any desired angle against the grinding wheel, which speedily removes any irregularities that may be present, and produces a smooth, finished surface.

From an inspection of the engraving, and the following description, the mechanical details will be comprehensive: The top of the table, when horizontal, is 2 feet 9 inches from the floor, and in area measures 24½ × 41½ inches. The front end of the table can be elevated by means of a hand wheel and screw, so as to obtain, in combination with a cone wheel, any desired angle. The arbor is made of 1¼-inch steel, and has two bearings, one 6 inches and the other 8½ inches long, and by means of the rack-pinion and lever it can be raised 6 inches if desired. The counter-shaft is very complete, the hangers having adjustable, self-oiling boxes. Instead of the rack-pinion and lever represented in the cut for elevating or depressing the arbor, the makers are now putting an attachment on these machines, by which the arbor is automatically raised and lowered very slowly.

Three speeds may be given—a vertical motion twice a minute being the most rapid, and once in about four minutes, the slowest. The action of the machine uses the whole of the emery wheel, and the wear on it is uniform.

This machine weighs 720 pounds complete, and is built by the Tanite Company, of Stroudsburg, Pa.



STOVE-PLATE MACHINE.

The Opening of Africa to Commerce.

The great interest that has lately been exhibited by the leading countries of Europe in fostering and encouraging the cause of African exploration, has a far more practical basis for its manifestation than the gratification of the desire to become acquainted with the physical features of this unknown country and with the characteristics of the races which populate it. For, behind the scientific explorer and the missionary—both equally zealous after his fashion—stand the merchant and the manufacturer, each none the less zealous after his fashion, to exchange the overflowing surplus of the factory and the warehouse for the rich and varied products of the soil and forest inhabited by the teeming millions of the interior of the "Dark Continent."

The knowledge gained concerning the wonderful natural resources of this *terra incognita*, imperfect though it has been, has borne excellent fruit in the establishment of an international society to promote the thorough exploration of the African continent, and to open it to the commerce of Europe. We find an excellent sketch of the origin and character of this society in the *Kansas City Review*, which we reproduce, as follows:

"For many years France, Germany, Austria, Italy, Belgium and Switzerland have had their own geographical societies, and have engaged in the business of African exploration with considerable zeal. But there was no unity, no concert of action, and consequently much money and many valuable services were simply squandered. The French and German travellers sometimes undertook the same problem at the same time; the Austrians and Italians did the same. At last, in 1876, the happy thought of international cooperation and economical division of labor and application of funds occurred to several leading geographers of continental Europe, and this idea was elaborated so far and so successfully that an international association for the exploration of Africa was fully and effectively organized, and met at Brussels under the intelligent and distinguished presidency of the King of the Belgians. In this association all the leading nations of Europe were represented except Great Britain, and a branch society was set up in the United States, under Mr. Latrobe's presidency, with Mr. H. S. Sanford (late United States Minister to Belgium) and Mr. Schiffelin, of New York, delegates of the society in Europe. The organization of the society was very complete and rational. Local geographical societies became branches of the international, which directed movements and disbursed funds. These local societies have two classes of members—those who pay annual dues, ranging from $2 to $5, and those who purchase life memberships at at average of about $100 each. The life membership fund is to be permanently invested. The interest received and the annual dues are applied to the fitting out and support of exploring expeditions. Another part of the society's work, which is most effective, and which promises in the end to do a great deal toward opening up Africa to travellers and trade, is the provision agreed upon and put in force for establishing stations or depots at important points on the great routes, where travellers may be received and obtain supplies at their cost. These depots, of which a good number have already been equipped, are to be furnished with goods, provisions, medicines, arms, instruments, etc. They are to be in charge of Europeans, with a native staff, and the person in charge is to increase in every possible way his knowledge of the surrounding and adjacent country, its resources, etc. The Italian government has for years maintained such a station on the frontiers of Abyssinia, and other stations have been founded between Bagamorgo and Ujiji, and at Nyangwe, on the Lualaba. The geographical, ethnological and commercial knowledge to be gathered up in this way will be very extensive and of the utmost importance. Already the reports from the stations embody a vast amount of information.

"The international association has practically solved the greatest difficulty in the way of the African problem—namely, that of transportation. Hitherto it has taken travellers many months, and cost them great sums, to get from the coast to the interior. The bite of the tsetze fly, which infests all the tropical regions of Africa, is fatal to the horse, the mule, the donkey, and the ox Consequently, all goods have had to be carried on the heads of porters, who could not as a rule carry more than from 50 to 75 pounds each, who had to be fed and paid, and who were insolent, disorderly, unreliable, and sure to desert just when their services were most needed. As the only currency of Central Africa is beads and calico, it took an immense corps of attendants to enable the traveller to get up from the coast, and the more porters the more mouths to feed and the greater the cost of the expedition. The international society has, however, substituted Indian elephants for porters, and the experiment has succeeded wonderfully. In a letter from Brussels of the date of October 17, 1879, speaking of the progress made by MM. Popelin and Vanden Heuvel, of the Belgian branch, and of the successful passage of the Mahata, we are told that Mr. Carter's elephants joined the explorers in good condition at Mpwapwa. The elephants, laden with about 1,000 pounds apiece, succeeded in crossing the mountains, swimming the rivers, and traversing the swamps and ravines. Contrary to the opinion generally received, they were able to dispense with bread, and to subsist on such provender as the country furnished. They journeyed across the districts infested with the tsetze, the bite of which, as is known, is mortal to horses, cattle and asses. Literally covered with these insects, they did not seem to suffer even annoyance. Another letter of still later date says: 'It remains to inform you, that the elephants have so far perfectly sustained all the fatigues and all the privations to which they have been exposed. They braved the Marenga-Ukali; they have remained forty-two hours without water, and thirty-one hours without food, marching twenty-seven hours laden with more than a thousand pounds apiece.'

"This is conclusive, and it would seem that as soon as the transportation problem is solved, the complete opening up of Africa to commerce is only a question of time. That continent is very rich in all sorts of vegetable and mineral resources; it has a large population, and all the civilized world is interested not only in finding new markets for their goods, but new fields to which emigrants may go in search of a living."

Putting up and Running Steam Pumps.—The Dean Pump Works, of Indianapolis, gives the following valuable hints on the management of steam pumps: Never use a smaller pipe on the suction than the list indicates. Avoid right angles in the pipe where it is possible. Where it is practicable, make bends with a large radius. Put a foot valve and strainer on the end of the suction pipe. Do not place the pump more than 29 feet from the water. Where hot water is pumped, the supply must be above the pump. Make all joints in the suction pipe tight. A small leak in the suction is very detrimental. Keep the stuffing boxes nicely packed. Oil the pump before starting it, and keep the oil wiped off where it is not needed.

Some engineers seem to think that if their boilers are supplied with water, there is no need of looking after the pump or taking any care of it. A good pump is as worthy of being taken care of as a good engine, and we would suggest to all engineers and persons using or having charge of pumps, that they spend a few minutes every day in cleaning them up, removing all extra oil on them, wiping off the dust and dirt, and seeing that they are in good condition and working well.

Handling the Sugar Beet.

There is no industry, at all comparable with it in magnitude, that can be said to be so completely the product of modern science as the manufacture of beet sugar. It was only established successfully on the commercial scale after many obstacles and reverses, and the history of the industry is the record of a magnificent triumph of science benificently applied to overcome obstacles of the most discouraging description. Not a single branch or portion of the manufacture has been overlooked by manufacturers in their efforts to encourage and cheapen the cost of production by the use of labor-saving devices. As an illustration of the ingenuity that has been expended in perfecting the smallest details of this manufacture, we reproduce herewith some illustrations from the lately published work of Mr. Lewis S. Ware, on the sugar beet, noticed in our issue of last month, showing one of the most ingenious of the several methods in vogue for cheaply and expeditiously transporting the beets from the fields to the factory.

Several causes, as Mr. Ware points out, have contributed to the necessity of designing improved methods of expeditiously handling the beet crop. The chief of these are, the frequent bad condition of the roads, from rain or snow, when the beet harvest commences, rendering transportation by ordinary wagons drawn by oxen or horses, exceedingly tedious and difficult; and the importance of gathering the entire crop with the least possible loss of time, to avoid its injury from frost. For these and other reasons, a number of improved methods have been proposed, and are in common use, the special circumstances in each case determining which of the several plans in vogue is best adapted.

One of the earliest suggestions to be introduced was the use of road locomotives to replace hauling by animal traction, and this plan is still used, in one form or another, where the condition of the highways permits of it. The use of small cars (*porteurs*), running upon a portable track, is more generally preferred, being convenient and not expensive. The track can be readily taken up and removed as necessity requires, and the use of horses for traction under these circumstances can be advantageously retained. Mr. Ware, in describing this plan, states that the train of "porteurs" is composed of a series of small cars, each having a capacity of from 110 to 220 pounds. The first of these has four wheels, the others only two; the weight thus supported by the track is distributed over a great length. The number of these cars varies with the condition of the ground over which they pass; but on a dead level he estimates that a horse can draw 22,000 pounds, and a man from 2,200 to 3,300 pounds. This system appears to be in use at some of the largest sugar factories of France and Belgium, and is affirmed to be about four times as cheap as the ordinary method of transportation. Several modifications of this system are used, but they are all substantially the same in principle.

The plan we illustrate in the engravings on this and the opposite pages is essentially different from the foregoing, being a system of aerial transportation, and requiring certain favorable conditions and circumstances to permit of its profitable adoption, to which we shall refer further on. Two methods of aerial transportation are in use for this purpose; in one the movement is given to the wire rope, and in the other the rope is stationary. The former requires a more elaborate plant, and can be used satisfactorily for 6 or 8 miles, or even greater distances.

In the second plan, which we illustrate, the wire rope is stationary—fixed at both ends, and the beets, packed from the fields in baskets, are conveyed to their destination by gravitation alone, the slant of the wire being 21 millimeters to the meter, (nearly an inch to the yard). The rope is supported by the arrangement shown in Fig. 1. To avoid danger of breakage at the point of intersection of the rope with the supports, the arm A is provided with a counterbalance to neutralize the shock of the passage of each basket.

Fig. 2 shows the general plan of the system. The loaded baskets are brought to the starting place and hoisted one after the other by a windlass to the wire, and started off. These arrive at the factory without further attention, where they are unloaded. The empty baskets are returned by means of a second rope, which, having less to support, has a smaller section than the carrying rope. The slant of the returning rope is of course the reverse of the other.

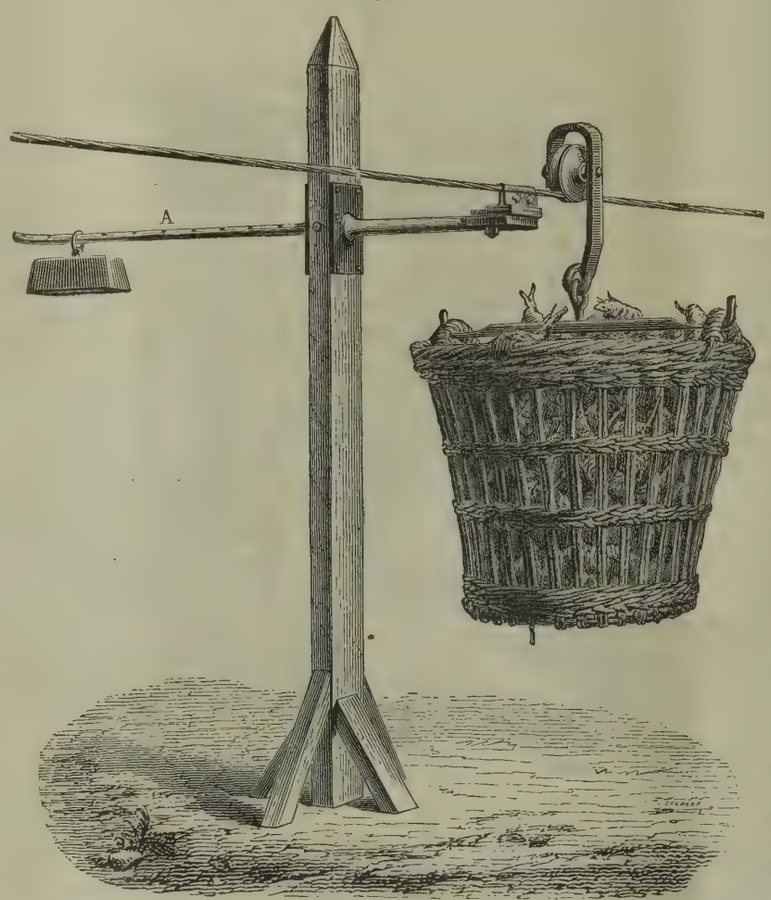


Fig. 1.—STATIONARY WIRE ROPE SYSTEM.

This system can be worked by two men and a boy, but if with a greater number of hands, as much as 100,000 kilograms (220,000 pounds) of beets can be sent to the factory daily. Mr. Ware speaks of this system as being excellent for distances not exceeding several miles. Another system in use at as many as fifty or more factories in France and Belgium, consists of the employment of a system of underground pipes of cast-iron, through which the juice—previously expelled from the beets by pressure in small buildings called "raperies"—is pumped to the factory. The juice, before leaving the "raperies," is united with about 5 per cent of lime water, to prevent fermentation, and is then sent through the pipes at a velocity of from 82 to 164 feet per second. These pipes are manufactured with the greatest care, and previous to using are tested by a hydrostatic pressure of 15 atmospheres, (about 225 pounds). They are made in lengths of 98.4 feet, carefully jointed, and given an external and internal covering of tar. The line is laid at a depth of 2.6 feet in the soil—a depth sufficient in this region of Europe to escape the action of frost—and follows the general undulations of the ground over which it passes. The line is carefully guarded, and the least escape, which will be indicated by the diminution of pressure on an indicator at each end of the pipe line, is at once corrected. The point of the leak speedily betrays itself by the appearance of a froth on the surface of the ground. Accidents from this source, however, are said to be of rare occurrence.

For the use of the illustrations accompanying this article, we acknowledge our obligations to Messrs. Henry Carey Baird & Co., publishers, Philadelphia.

Edison's System of Electric Lighting.

As anything that Mr. Edison might say, or authorize to be said for him, in reference to his much-talked-of system of electric lighting, will have a special interest to our readers, we reproduce in the following quotations some explanatory remarks concerning it which we find in an elaborate article by Mr. Francis Upton, published in *Scribner's* for February, and which Mr. Edison endorses over his own signature as being the first correct and authoritative account of his invention that has yet appeared. It is as follows:

"Mr. Edison's idea in regard to the electric light, was that, in all respects, it should take the place of gas. Following the analogy of water, the inventor conceived of a system which should resemble the Holly waterworks. As the water is pumped directly into pipes which convey it under pressure to the point where it is to be used, so the electricity is to be forced into the wires and delivered under pressure at its destination. In the case of water, after being used, it flows away by means of a sewer pipe, and is lost. But it is easy to imagine that the water used in working machinery, for instance, instead of being lost, might be returned to the pumps and used over and over again. With such a system as this, we should have a perfect analogy to the Edison electric lighting system. The electricity, after being distributed under pressure and used, is returned to the central station. As the light results from no consumption of a material, but is mere transmutation of the energy exerted in the pumping process, it is therefore seen that all which is essential to an electric lighting system is the generator, (or pump), the two lines of wire—one distributing the electricity, the other bringing it back—and a lamp which transmutes into light the energy carried by the electricity when it passes from one wire to the other, and in which the energy of the pressure expresses itself as the light. In Edison's invention the amount of electricity delivered in the lamp is determined by the size and resistance in the carbon, just as in water the amount of flow is determined by the size of the openings. As a great many small jets of water can be supplied from one pipe, so a great many lamps or small escapes for electricity can be furnished from one wire.

"As in the case of water, the amount of work done by electricity—either as illuminant or motor—is dependent quite as much upon the pressure from which it escapes as upon the quantity passing through the wires. We might have a system of lamps which would give a certain amount of light from large quantities of electricity escaping under low pressure.

"As in either case the amount of electricity flowing through a wire is in proportion to the size of the wire, it will be readily seen that the application of pressure

made by Mr. Edison obviates the main difficulty in the way of subdivision (that is, in the way of the domestic use of the electric light), namely, the enormous size and cost of conductors. The well-known principle of the effect of pressure upon the dynamic power of electricity has never been utilized, because the proper lamp was still unknown. This lamp is Mr. Edison's main discovery. In order to utilize this, one of the plans devised by him was to make the flow intermittent. Enough was allowed to escape in a short time—say one-third—to keep the lamp all the time supplied. It would of course require a large wire to furnish the quantity of electricity needed, yet two-thirds of the time the wire would be inactive, during which period it could be used to supply two other lamps constructed on the same principle. According to the doctrine of probabilities, one-third of a large number of lamps would be in use all the time. Such being the case, the cost of a conductor would be divided among three lamps. The lamps were so constructed as to burn steadily all the while, although the electricity was passing through them only one-third of the time. Besides the enormous practical value of the electric light as a domestic illuminant and motor, it furnishes a most striking and beautiful illustration of the convertibility of force. Mr. Edison's system of lighting gives a complete cycle of change. The sunlight poured upon the rank vegetation of the carboniferous forests, was gathered and stored up, and has been waiting through ages to be converted again into light. The latent force accumulated during the primeval days, and garnered up in the coal beds, is converted, after passing in the steam engine through the phases of chemical, molecular and mechanical force, into electricity, which only waits the touch of the inventor's genius to flash out into a million domestic suns to illuminate a myriad of homes."

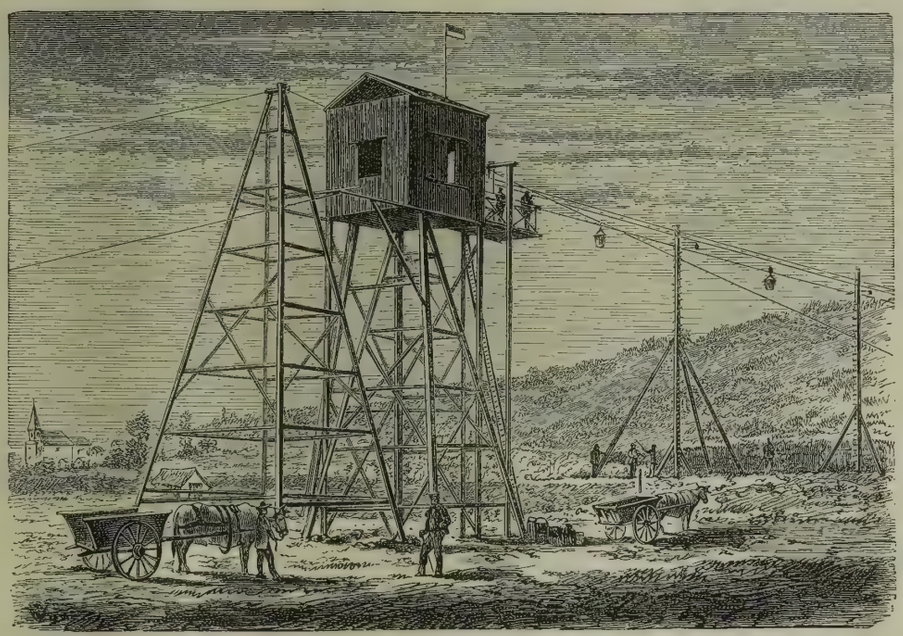


Fig. 2.—THE START.

How to Judge of Leather in Belts.

Without entering into the question of the merits or demerits of rubber or other kinds of belting, one cannot but notice the want of unanimity of opinion, even among belt manufacturers, as to what really constitutes the best leather for making belts to convey power in running machinery; and, if we include makers of belts on the other side of the Atlantic, the differences in theory and the divergence in practice are much wider than they are here. As a rule, too, this is a matter about which machinists generally have but little information, and are, with here and there only a rare exception, but indifferent judges.

The best belt, theoretically, is that which combines the highest tensile strength with the greatest power to resist wear by attrition, being at the same time subject to little change by dryness, moisture, heat or cold. These qualities, supposing the manufacture to be ordinarily good, are mainly dependent upon the tanning. In Europe there is very little difference known or acknowledged between good sole and good belting leather. The heaviest or "plumpest" leather is usually considered there the best for belts, as well as for the soles of boots and shoes. Our belt makers, however, recognize an essential difference. The sole of a boot or shoe, particularly in all heavy work, needs to have but little flexibility, but must have the greatest possible capacity to resist wear by attrition, and be, as far as practicable, impervious to water, while it is never subjected to any test of its tensile strength. Sole leather, therefore, in all the toughest wearing grades is made as thick and solid as the tanner can make it; great care is taken to open wide the pores of the hide, in the early part of the tanning process, to see that all the gelatine is saved to combine with tannin, and that the hide is left in the tan liquors long enough to take up all the tanning it will absorb. This makes the finished leather oftentimes a great deal thicker than the original hide. But such leather, it need hardly be said, would not be the best for making belts, for it has little flexibility, and its tensile strength has been greatly impaired by the straining of the fibers of the hide to take in the large amount of tanning it has received.

The tanner who would make the best belt leather, however, although he cannot swell the fibers of the hide with tanning to the extent above noted, must produce a firm, solid belt with not a little of the elasticity and strength of steel; it must be sufficiently flexible, and yet of great power to resist wear by attrition, and to stand, with little stretching, the heaviest direct strain. These qualities are best obtained by an amount of tanning which will make the finished leather but little thicker than the raw hide of which it is made. On cutting a piece of sole or belting leather, one will notice the network of hide fibers interlacing each other, and which, before tanning, were surrounded with gelatine. These fibers give the hide its great tensile strength, and any considerable displacement of them by the transformation of the hide into leather impairs this quality. A piece of good belt leather, therefore, when freshly cut, should look bright, with the intervening spaces between the fibers fine, even and regular. The texture should be uniform throughout, and with the utmost solidity there should be great elasticity.

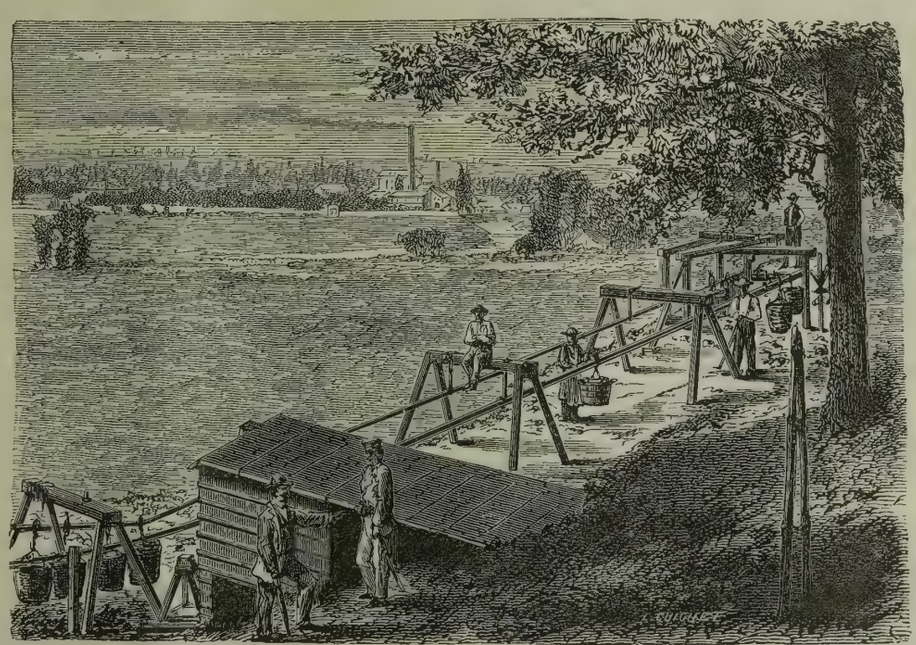


Fig. 3.—THE ARRIVAL.

How Slate Pencils are Made.—Broken slate from the quarries is put into a mortar run by steam, and pounded into small particles. Thence it goes into the hopper of a mill, which runs into a "bolting machine," such as is used in flouring mills, where it is "bolted," the fine, almost impalpable flour that results being taken to a mixing tub, where a small quantity of steatite flour, manufactured in a similar manner, is added, and the whole is then made into stiff dough. This dough is kneaded thoroughly by passing it several times between iron rollers. Thence it is conveyed to a table where it is made into "charges"—that is, short cylinders, 4 or 5 inches thick, and containing from 8 to 12 pounds each. Four of these are placed in a strong iron chamber or "retort," with a changeable nozzle, so as to regulate the size of the pencil, and subjected to tremendous hydraulic pressure, under which the composition is pushed through the nozzle in a long cord, like a slender snake sliding out of a hole, and passes over a sloping table slit at right angles with the cords to give passage to a knife which cuts them into lengths. They are then laid on boards to dry, and after a few hours are removed to sheets of corrugated zinc, the corrugations serving to prevent the pencils from warping during

the process of baking, to which they are next subjected in a kiln, into which superheated steam is introduced in pipes, the temperature being regulated according to the requirements of the article exposed to its influence. From the kiln the articles go to the finishing and packing room, where the ends are thrust for a second under rapidly revolving emery wheels, and withdrawn neatly and smoothly pointed ready for use. They are then packed in pasteboard boxes, each containing 100 pencils, and these boxes in turn are packed for shipment in wooden boxes, containing 100 each, or 10,000 pencils in a shipping box. Nearly all the work is done by boys, and the cost therefore is light.

Defective Boiler Rivets.

We give in the following some illustrations of a remarkable case of defective riveting of a boiler that lately exploded, and which are reported by our informant (*The Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Co.) to be samples selected from a large number taken from the same boiler. This is no doubt an exceptional case, but as such is worthy of serious attention and notice as serving to show to what lengths carelessness and ignorance on

Fig. 1.

the part of workmen may at times extend, where their work is not intelligently superintended. Our informant is evidently right in its inference, that official rules regulating the thickness and quality of boiler plates offer but little protection, if they can be sent out from the boiler shop so miserably joined together.

A look at the illustrations, interpreted in the light of the accompanying text, will tell the story better than we can, viz.:

"To those who are at all conversant with boiler mechanism, the ten illustrations of defective boiler rivets herewith presented will speak for themselves. To those who have seen such things, and can read their character in these cuts, it will perhaps be something of a surprise to learn that they all came from *one single boiler*, that was, not many months ago, wrecked by an explosion. The publications of this company have before contained illustrations of bad rivets, and quite a collection has been made up from different parts of the country, and it would not be difficult perhaps to select from its cabinet a set similar to that presented here;

Fig. 2.

but no single case is on record which will furnish a parallel in number and badness. They are samples selected from a number taken from the same wreck. It would be an insult to the common sense and a slander on the business character of the most careless and illiterate proprietor or master workman to intimate that such work was knowingly permitted to leave his yard, and this article must therefore be set down as another chapter of curiosities of carelessness and ignorance.

"That such work does sometimes escape the vigilance of even the most honest and capable proprietor, is an

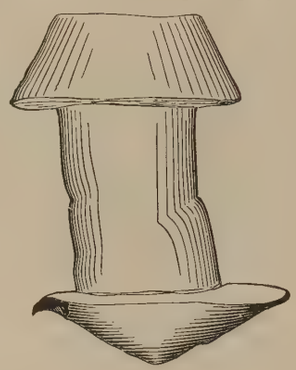


Fig. 3.

important fact in the history of steam industries. Correctly interpreted, it may prove an important help in dispelling the cloud of mystery which has so persistently clung around boiler accidents. Laws and official rules regulating the thickness and quality of the plates seem to offer but little protection when they are joined together so unskillfully. Perfect immunity from accidents can only be secured through careful and intelligent inspection as the work proceeds, supplemented by periodical examinations after being set up."

Fig. 1 shows a rivet which was "driven" in over-set holes; conical point broken off by the tearing apart of the plates; the head nearly severed from the body; probably weakened in "driving." Fig. 2.—Rivet which was "driven" in over-set holes. Head broken off by the tearing apart of the plates; conical point also nearly broken off—bad sample of "driving"—cone too flat to properly hold down the "calking edge" of the plate. Fig. 3.—Rivet "driven" in slightly over-set holes. Point eccentric and not symmetrical; too

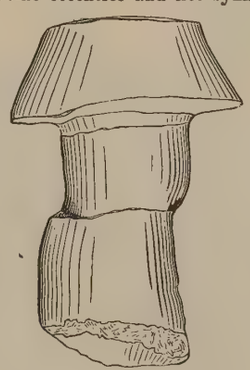


Fig. 4.

flat to properly secure the calking edge of the plate. Fig. 4.—Rivet "driven" in badly over-set holes. Very weak. See Figs. 5, 6 and 7, which were "sheared" at the time of the explosion. Dark shading on lower end of Fig. 4 indicates an old crack. Figs. 5, 6 and 7.—Samples selected from a number taken from a "sheared" seam, which was believed to be the initial break from which the explosion arose. They were no doubt similar to Fig. 4 before they gave way. Fig. 8.—Rivet "driven" in over-set holes. Was probably fractured under the head in driving, (similar to Fig. 1). Taken from a seam that was broken through the rivet holes. Figs. 9 and 10.—Long rivets taken from a broken casting which they were intended to secure to the wrought-iron head of the boiler. The holes in the wrought-iron plate were "drifted" and chipped to allow the rivets to enter, as shown by the enlarged portion of the body. This irregular upsetting, and the sharp little wave of iron on the body of Fig. 9, indicate the thickness of the wrought-iron plate.

The illustrations of these rivets are full size, and were made from photographs.

An interesting Boiler Explosion.

(*Concluded from Page 34 of February Number.*)

In January, 1879, this boiler was inspected by the Hartford Steam Boiler Inspection and Insurance Company, and found to be in a condition requiring repairs. The plate replaced by the new plate, T, Fig. 4, (page 35 of our February issue), was blistered and thin in spots, and the tubes were quite worn and thin. The attention of Messrs. Wilt & Son was called to the necessity of immediate repairs, and they proceeded at once to have them made. A plate of new iron was put in place of the blistered and thinned plate, and the tubes were replaced by new ones throughout. The repairs were made by the People's Works, Jacob Naylor proprietor, a house of long standing and high reputation in the city of Philadelphia.

It was believed at the time that unusual care had been manifested by all parties concerned, to put the boilers in good condition. On the following May 14th, the hydrostatic test was applied to the boiler, such test being required by the city inspection ordinance. The pressure to which the boiler was limited was 80 pounds to the square inch. The ordinance requiring this test is as follows: "He (the inspector) shall also test each boiler by hydrostatic test to a pressure one-third ($\frac{1}{3}$) greater than that at which the boiler is to be used." In a previous portion of this section of the or-

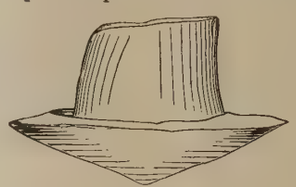


Fig. 5.

dinance pertaining to the quality of the iron used in the construction of boilers, is the following language: "They (the plates) shall have the maker's name and the quality of the material stamped upon each sheet, in accordance with the inspection laws of the United States for steamboats." I mention this to show that the committee or commission that framed the ordinance doubtless had the United States law before them, and regarded some at least of its provisions as worthy of adoption. The United States inspection law requires the use of the hydrostatic test in making the inspection of steam boilers. The language of the law is as follows: "The hydrostatic pressure applied must be in the proportion of 150 pounds to the square inch to 100 pounds to the square inch of working pressure allowed." In framing the Philadelphia law, the commission, knowing that the use of the hydrostatic test was liable to great abuse, by putting boilers under excessive and unnecessary strain, together with the use of cold water in hot boilers, no doubt decided to modify the United States law in this respect. The hydrostatic test is almost universally applied cold—that is, the water used is cold—and if the pump is unskillfully handled, the shock from an inelastic excessive pressure may result in injury. We do not believe it constitutes a sufficient and entire inspection of a steam boiler under any circumstances, even the most favorable.

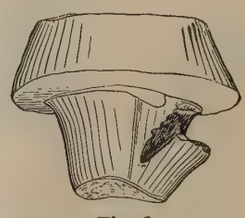


Fig. 6.

To return to the inspection of the boiler of Messrs. Wilt & Son. I have said that the limit of pressure was 80 pounds to the square inch. The inspector arrived at their works as per appointment, to apply the hydrostatic test. He found the boiler nearly filled with water, and a pressure of steam of 15 pounds to the square inch. It required but little water to completely

fill the boiler and raise the pressure to the required hight. It will be observed that the water must have been in temperature slightly above the boiling point. The metal of the boiler was hot, and in a much better condition to yield to strains occasioned by the pressure than if it had been cold, and cold water used. According to the ordinance, the test would have been ($\frac{1}{8}$ of 80) +80=106 pounds. The engineer in charge requested particularly that the pressure be run up to the United States standard, namely ($\frac{1}{4}$ of 80)+80=120 pounds, or 14 pounds in excess of the requirements of the city ordinance. The inspector, a man of experience, knowing that the water in the boiler at the boiling point, and the metal of the boiler at a corresponding temperature were favorable conditions, and that a pressure of 120 pounds under such circumstances was no more unfavorable to the boiling than 106 pounds would have been with cold water, acceded to the wishes of the engineer.

This has been characterized as an injudicious application of the hydrostatic test. I would inquire of the gentlemen so deciding, whether their opinion was made up after intelligent investigation and a practical knowledge of the subject, or from blind prejudice?

Another criticism which has been made, is, that the iron of the shell of the boiler was of an inferior quality, and that the judgment of the inspector was at fault in allowing a defective plate to remain in the shell. Two blisters, marked U and J, Fig. 4, (see page 35), were discovered, which were so thin that they were pared off in the usual manner without materially reducing the thickness of the iron, and from the fact that none of the lines of fracture passed through these so-called weak and defective spots, it is conclusive evidence that the inspector's judgment was not at fault in allowing

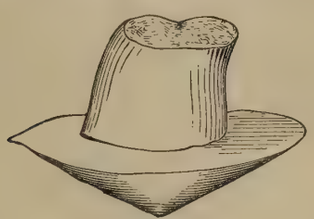


Fig. 7.

them to remain as they were. To be satisfied in regard to the quality of the iron, and of its tensile strength, we employed Dr. Charles Huston, of the Lukens Rolling Mills, (a gentleman who has given this subject careful study), to make tests of numerous specimens cut from different portions of the plates, both in the direction and across the fiber. The testing machine used was of Fairbanks' make, and, having been repeatedly proved by United States standard weights, was known to be correct. The following letter of Mr. Huston gives the result of the tests:

To the Hartford Steam Boiler Inspection and Insurance Company:

Gentlemen: Enclosed I have the pleasure of handing you the results of the tests of the eighteen samples of boiler plate taken from the exploded boiler of Wilt & Son, and which you sent me a few days ago. The tests were carefully made on the improved machine of Fairbanks & Co., at the Permanent Exhibition in Philadelphia. I used this machine because it has been repeatedly proved to be correct with United States standard weights. All the tests were within the limits prescribed by the Board of Inspectors of Steamboats for the United States, the lowest with the grain 50,000 T. S. and 12.3 contraction of area. This is all the more remarkable from the fact that the iron had been in use several years, undergoing repeated heating and cooling during all this time. With the exception of the one sample above, all the others showed remarkable results, as, for example, C2, with the grain 59,000 T. S. and 28.6 contraction of area. I can see no fault to be found with the quality of the iron. Yours, etc., Chas. Huston.

Lukens Rolling Mills, Coatesville, Pa., Sept. 25, 1879.

In view of the above, it will be evident to any intelligent, candid mind that the men who pronounced the iron as of inferior quality, were either ignorant of the characteristics of good iron, or made no careful experiments, or, as is probably the case, allowed themselves to be influenced and prejudiced by other parties. The only thing that could be said against the iron in the light of the above tests, is, that it is slightly crystalline; but who has tested eighteen specimens of iron taken from different parts of a boiler that has been in use nine years, and found less crystals and a greater average of contraction of area? It is always well to be intelligent on

Fig. 9.

a subject before being censorious. Hence, to an honest, candid mind, criticism of the inspector's judgment will fall to the ground. And to show that in the minds of persons who have been looked upon as competent judges in such matters, it is proper to say that the Chief of the Inspection Bureau of the city of Philadelphia has said to several gentlemen that no fault could justly be found with the inspection of the boiler or the inspector making it, and that he would have passed favorably upon it, had he made an examination the day before the explosion. It is now proper to ask the men

Fig. 10.

who were so ready to condemn the iron in the boiler, and the hydrostatic test which was applied, what reasons they had for arriving at such conclusions? If they have made extended and exhaustive experiments in these fields, they should enlighten the public by giving information, and not strive to cripple one of the sources of that information which steam users are anxious to obtain.

The question now arises, What did cause the explosion of this boiler? By referring to Fig. 1, (page 34), it will be seen that the initial rupture occurred at the joint where the old and new iron were joined, T being the new plate and W the old plate. It will also be noticed that the break was in the line of the rivet holes of the old plate, and that this portion of the boiler was in, or directly over the furnace, and in the hottest portion, hence subjected to extreme expansion. The fuel used was shavings and the refuse of the planing mill. This fuel makes a quick, hot fire, the furnace often varying greatly in temperature under the old practice of feeding by frequent opening of doors. The new plate, marked T, was about .045 thicker at the "lap" than the old one (W), and consequently yielded less readily to the effects of expansion and contraction. This threw the burden of the strain on to the thinner plate at the "lap." This strain, varying with the varying temperatures and pressures, developed a weakness which resulted in fracture, as shown in Fig. 1; the thinner plate at this point was probably less fibrous because of long use, and therefore the more liable to fracture.

Some of the practical men who examined the fracture, were quite confident that the crack was first developed on the inner surface of the plate between the laps. When examined with a glass, the fractured edge

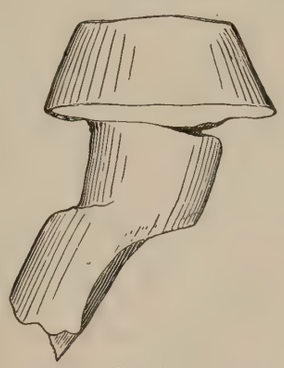


Fig 8.

appeared as though the incipient crack had been gradually growing larger until the metal gave out. This would not be an unusual result of the strains to which a boiler would be subjected under the conditions named. If the skin of the iron is once broken it locates a weak spot, and if this spot is bound up between two plates riveted together, it would be impossible to discover it.

The question will naturally arise, Has any similar case occurred in our experience? We have not infrequently found similar results when the plates were the same thickness, if one was bound more rigidly, by bracing or otherwise, than the other; and with the plates of different thicknesses, it will be readily seen that the thicker and less yielding one would be relatively as though it were stiffened and bound by bracing. All this could occur and still the iron in the thinner plate be of good quality. Fractures in boiler plates do not always result from poor iron, but from unequal strains, which are aggravated by high pressures and temperatures—or perhaps it would be better to say, from greatly and suddenly varying temperatures and pressures; and when a boiler is used up to, or near its full capacity, these sudden changes in temperature and variations in pressure are more destructive than if the boiler is moderately loaded.

Boilers rarely rupture in the middle of a plate, unless the plate has been burned from an accumulation of doposit, or from some other cause; but ruptures are not uncommon at the lap, nor in the line of the rivet holes, showing that the plates in the effort to adapt themselves to the strains incident to use, throw the burden on to that portion which is ill adapted to equally distribute the strain. Therefore, if there are

sudden and great changes in temperature, or in pressure, there will be liability to fracture.

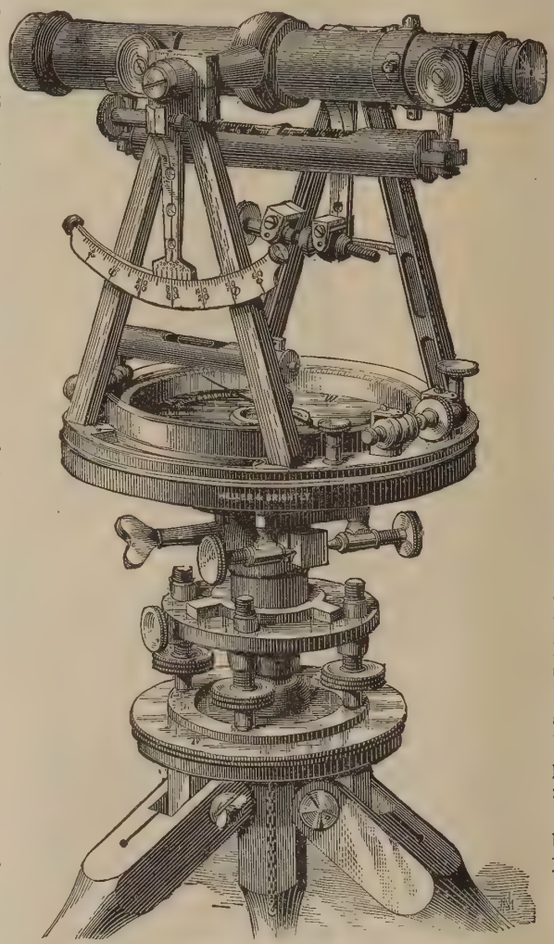
We are not surprised at the development of unexpected defects and weaknesses in boilers. We have seen the best of iron ruptured and fractured, apparently without cause. But careful examination has always resulted in a satisfactory explanation.

The Modern Surveying Instrument and its Improvements.

The instruments used by civil engineers and surveyors for taking their surveys in the field have been so changed in their construction, device on device having been added to facilitate field operations, and others for keeping the instrument and its various parts in proper order and adjustment, that the last few years has almost created a new instrument; and if any of the old tribe of engineers who "laid out" the Pennsylvania Central, the Illinois Central, the Erie, or any of our earlier railroads, could revisit the scenes of their labors, whatever else they might recognize, their field instruments would have passed most decidedly out of their knowledge, as the neat, compact transit of to-day is as different in its mechanical construction from its progenitor as a fine chronometer is from a smoke-jack.

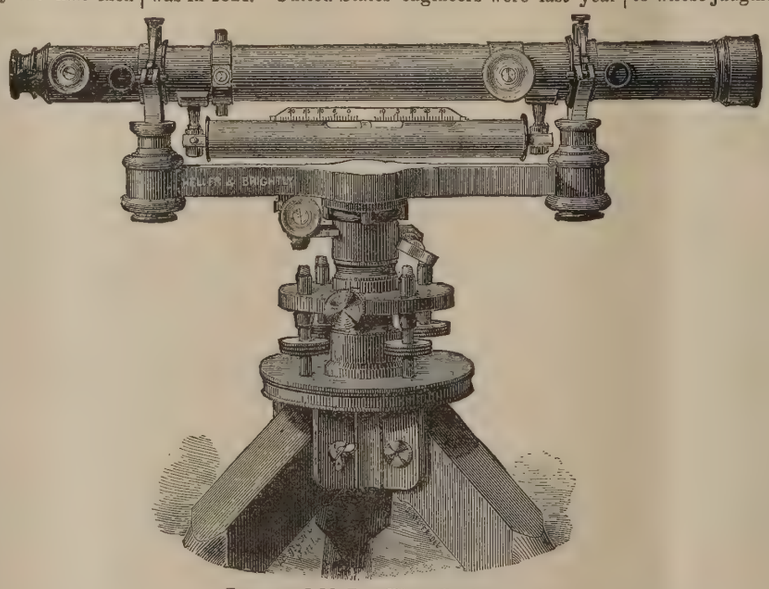
To illustrate in some degree what these changes are, we give two illustrations of the modern improved instrument, and briefly mention the changes in them from the old form. The engineer, on glancing at the illustrations, will see how "low-down" it is as compared with the old form, or, in other words, how near to the tripod head the instrument proper is placed—the object of this being to increase the steadiness. One of the greatest enemies to field instruments is the flying dust and grit which settles on the various parts, and acts like fine emery on the working portions, this dust doing more damage in a few weeks than is accomplished by months of actual wear in the field. In the South and West this dust nuisance becomes a veritable plague, and the United States engineers now engaged in surveys of the Mississippi river, tell, what appear to the uninitiated, veritable Munchausen stories of the clouds of flying dust that prevent an object ten feet in front of the instrument from being seen; in the more quiet moments how this dust settles by the half inch on all parts of the instrument, obscuring telescope, graduations and all; and how, when the winds rage, a miniature "Tilghman sand blast" pits all portions of the instrument, destroying all the ornamental bronzing and lacquering of the maker.

So much for the dust; now for the efforts to keep it off the working parts. The vulnerable parts of a transit, and those liable to injury from this cause, are the tube that carries the "object glass" of the telescope, the centers, the joints of the various plates, the tangent, clamp and levelling screws. All of these parts are now sealed from the dust by means of what we may call the "stuffing box" process. "Lost motion," or "back lash" in the various "tangent" or "slow motion" screws is also overcome by the "fixed spiral spring and follower" modes. The "Hoffman quick-levelling tripod head" increases the speed of the field work, and the "shifting tripod head" plumbing the instrument precisely and easily over a point on the ground. The enormous increase of power and range that modern optical science has given to the telescope is also a special feature of the modern instrument, for, without increasing its length, the transit telescope now magnifies 28 diameters as compared to the 12 diameters, which, until within a few years, was its limit, and of course this increased range allows of the attainment of greater nicety and precision in the field work, of which it will suffice to mention one example: In the annals of the State of Pennsylvania (Pennsylvania State Improvements—main line) it is



Combined Transit and Levelling Instrument.

mentioned as a remarkable specimen of unusual accurate levelling, that in a circle of 12 miles that was levelled the error was only one foot and two-10ths—this was in 1824. United States engineers were last year



Improved Y Levelling Instrument.

engaged in running a line of levels between the Chesapeake and Delaware bays for the purpose of determining the feasability of a ship canal. In testing the new levelling instrument furnished by the United States for this work, a line of test levels was run of over 10 miles, and the difference of level on the closing bench mark was only five-thousandths (0.005) of a foot.

The improvement in the telescope has also brought into more general practice the use of stadia or micrometer wires as a substitute for chaining and taping in a great majority of cases. This, together with a vertical arc for "angles of elevation and depression," long level under the telescope for accurate levelling, a sensitive compass needle, means for taking up wear in the wooden tripod legs, and right angle sights for "offsetting," make up the complete instrument.

As regards the levelling instrument, all the improvements mentioned above as being on the transit, (that is, dust guards, etc.,) are placed on the level; besides a number of others peculiar to this instrument; of these are, first, agate bearings for the telescope to revolve in; means for determining the verticality of the vertical cross-wire; self-acting devices for confining the telescope in its Y's; increased sensitiveness in the level bubble proper, and in the absolute projection of the object-glass slide in a perfectly straight line, so as to insure absolute truth of the "adjustment of the line of collimation" in long and short sights. The great bugbear of the surveyor, however, is weight, for, as one of them truly remarked, "after lugging a transit on the shoulder all day long, towards evening every ounce additional weight on it seems as heavy as a pound." This has also been attended to, all the parts being ribbed to lighten it; even the tripod legs are trussed and ribbed, instead of being solid wood as of old. There has also been an entire revolution in the mode of packing the instrument in its box, every part being placed on springs, so as to allow the instrument to accommodate itself to any position in which it may be placed; this is the more necessary as the export of instruments to foreign countries has become very extensive, and it requires tact to so pack a transit that it will reach Japan or China in reasonably good shape.

The above illustrations and improvements have been taken from instruments made by Heller & Brightly, of Philadelphia.

Artificial Diamonds.

Mr. MacTear's claim to have produced the diamantine form of carbon by artificial means, has been definitely pronounced to be baseless by Prof. Maskelyne, the mineralogist of the British Museum, the arbitrator to whose judgment the question of the identity of the crystalline particles of alleged diamond was referred. Prof. Maskelyne subjected the fragments to three several tests, all of which were answered in the negative, and the result obtained from any one of the tests applied would of itself have been sufficient to negative Mr. MacTear's claim. Maskelyne tested: 1st. The hardness. He placed some of the fine fragments between two plates of polished topaz and sapphire, and worked them to and fro; the material did not leave a scratch on the rubbing surfaces, but was itself ground to impalpable dust. 2d. The refractive qualities. He found it to present under the polarizer the phenomenon of double refraction. The diamond is isometric, and hence single refracting. 3d. The combustibility. He placed some of the fragments on platinum and heated them intensely. They did not burn, but were unchanged after cooling. The experiment was repeated by placing some real diamond dust alongside the alleged diamond of MacTear, on the platinum. The diamond dust was readily consumed; the other remained unchanged as before.

Either one of these tests would be sufficient to decide that the crystalline powder of Mr. MacTear was *not* diamond, and not carbon of any kind; but, taken to-

gether, they form an array of proof against the claims of Mr. MacTear that is simply irresistible. This gentleman, however, still refuses to be convinced of his error, and after affirming that he has performed Maskelyne's experimental tests with very different results, asks for a temporary suspension of judgment. We do not wish to metaphorically "sit down on" Mr. MacT., but in view of Maskelyne's very clear and decided statements, feel convinced that whatever the last-named gentleman may have succeeded in doing, he did not leave diamond fragments with Prof. Maskelyne to test.

Singular as it may appear, on the very heels of the announcement of MacTear's failure, there appears another statement from Prof. Maskelyne in the London *Times*, announcing in the most unqualified manner that another claimant for the honors of this achievement, has succeeded. The person in question is Mr. Ballentyne Hannay, a member of the Chemical Society of London. Prof. Maskelyne affirms with positiveness that Mr. Hannay sent him some crystallized particles presenting exactly the appearance of fragments of a broken diamond, and these fragments easily scored deep grooves in the polished surface of a sapphire. He concludes his letter to the *Times* as follows:

"There is no doubt whatever that Mr. Hannay has succeeded in solving the problem, and removing from scientific chemistry the opprobrium so long adhering to it; for whereas the larger part of the great volume recording the triumphs of that science is occupied by the chemistry of carbon, this element has never been crystallized by man till Mr. Hannay achieved the triumph which I have the pleasure of recording to-day. His process for effecting this transmutation is hardly less momentous to the arts than to the possessors of a wealth of jewelry. It is on the eve of being announced to the Royal Society."

It has transpired, however, since writing the above, that another English scientist, Prof. Roscoe, has expressed some doubts as to the genuineness of this last achievement. We give the statement however simply as a piece of interesting science gossip. We shall doubtless have the facts of the case before long.

Scientific.

Instinct the Result of Inherited Actions Unconsciously Performed.—Most naturalists, writes Mr. Charles Darwin in *Nature*, appear to believe that every instinct was at first consciously performed; but this seems to me an erroneous conclusion in many cases, though true in others. Birds, when variously excited, assume strange attitudes, and ruffle their feathers; and if the erection of the feathers in some particular manner were advantageous to a male while courting the female, there does not seem to be any improbability in the offspring which inherited this action being favored, and we know that odd tricks and new gestures performed unconsciously are often inherited by man. We may take a different case, (which I believe has been already advanced by some one), that of young ground birds which squat and hide themselves when in danger, immediately after emerging from the egg; and here it seems hardly possible that the habit could have been consciously acquired just after birth without any experience. But if those young birds which remain motionless when frightened were oftener preserved from beasts of prey than those which tried to escape, the habit of squatting might have been acquired without any consciousness on the part of the young birds. This reasoning applies with special force to some young wading and water birds, the old of which do not conceal themselves when in danger. Again, a hen partridge, when there is danger, flies a short distance from her young ones and leaves them closely squatted; she then flutters along the ground as if crippled, in the wonderful manner which is familiar to almost every one; but, differently from a really wounded bird, she makes herself conspicuous. Now, it is more than doubtful whether any bird ever existed with sufficient intellect to think that if she imitated the actions of an injured bird, she would draw away a dog or other enemy from her young ones; for this presupposes that she had observed such actions in an injured comrade and knew that they would tempt an enemy to pursuit.

Many naturalists now admit that, for instance, the hinge of a shell has been formed by the preservation and inheritance of successive useful variations, the individuals with a somewhat better constructed shell being preserved in greater numbers than those with a less well constructed one; and why should not beneficial variations in the inherited actions be preserved in like manner, without any thought or conscious intention on her part any more than on the part of the mollusk, the hinge of the shell of which has been modified and improved independently of consciousness.

A Feat of Triangulation.—A correspondent of *Nature* states that a noteworthy advance in geodesy has recently been effected by the junction of the network of measurements covering a large portion of the surface of Europe, with the African continent. The entire triangulation of Algeria was completed by French engineers some time since, and extended to the edge of the Sahara, in latitude 37°. M. Perrier, who had, in a great measure directed the triangulation of Algeria, has for the past eleven years been seeking the means of joining the network in that country with the perfect trigonometric system covering the surface of Spain, France, and England. For such an undertaking the most careful and painstaking preparations were requisite. As the result of his reconnoissances between 1868 and 1872, M. Perrier found that from all the trigonometric points of the first order between Oran and the frontiers of Morocco, the loftier crests of the Sierra Nevada on the Spanish coast opposite, were visible in exceptionally clear weather.

Arrangements were subsequently made with the Spanish Geographical Institute for the mutual and contemporaneous execution of the proposed plan. In order to insure the accuracy of the observations, which required the passage of signals over a distance of nearly 150 miles, it was decided to make use of solar reflectors and powerful lenses. The efficacy of such apparatus for even greater distances had already been tested by M. Perrier; still, for the measurements in question they appear to have utterly failed to answer the expectations based upon them, not a single solar signal being visible from any station. Fortunately, the success of the observations did not rest entirely upon this one system of signals. Preparations had likewise been made for the employment of the electric light, and on the summit of each mountain one of Gramme's electromagnetic machines, worked by engines of 6 horsepower, had been placed in position. On the 20th of last August all the stations were occupied, and the electric lights were displayed throughout each night. Then the patience of the observers was submitted to a long proof. The mists rising from the Mediterranean totally prevented the exchange of signals, until, after a delay of twenty days, one after another the electric lights became visible even to the naked eye. Perrier compared the intensity of the light on Tetica, about 160 miles distant, to that of α in Ursa Major, which rose near by. The observations were continued from September 9th to October 18th, when this task, for which such extensive preparations had been made, was completed in the most satisfactory manner. With its completion the scientific world comes into possession of trigonometric measurements of the most exact nature, extending from latitude 61° in the Shetland Islands, to lat. 34° on the southern frontier of Algeria.

Effect of Large Bodies of Water in Tempering the Cold of Winter.—The fact that a body of water in parting with its warmth to cool bodies of air moving over its surface, gives up to the latter an amount of heat greater in proportion to the amount of sensible heat it has lost than could be imparted by any other medium, by reason of its eminent specific heat capacity, is one of the elementary facts of natural philosophy, and one with which our readers are doubtless well acquainted. By reason of this fact, large bodies of water act as reservoirs of heat, which materially temper the cold of winter.

A calculation made by Dr. Forel, with regard to the Lake of Geneva, is highly instructive as showing how very important this factor really is. The facts observed by this savant are as follows: On December 19th just past, he took thermometric soundings in the lake, and found the surface temperature to be 5.6°, (42.08° Fah.,) and at the depth of 330 meters, 5.3°, (41.5° Fah.) Five days later the surface had cooled down to 5.4° (42.1° Fah.,) and he assumes that the lake was then occupied by a body of water of about 170 meters thickness having a temperature of 5.4° (42.1° Fah.); below that a layer having a temperature, as above, of 5.3° (41.5° Fah.,) and in the depths below 330 meters, a layer with a temperature of 5.2° (41.3° Fah.) From these data he calculates the amount of heat lost by the lake in those five days, and finds that it amounts to the astonishing quantity of ten billions of calories—a quantity which will be better understood by the statement that it would require to produce it, the combustion of 1,250,000 tons of coal. During this five-day interim, it is also noticed, the sky was generally covered with clouds, a circumstance that contributed largely to retaining this heat in the air, and doubtless will explain the phenomenal mildness of the weather in that region, in comparison with the cold that was quite severe in its effects elsewhere.

The Velocity of Light.—The recent calculations of the velocity of light by different methods, give figures which very closely agree with the older calculations of Foucault. To the figures lately found by Michelson, and noticed in this journal, we may add those of Prof. Pliny E. Chase, who has just contributed to the *Journal of the Franklin Institute* an ingenious approximation to the velocity of light by the nebular hypothesis. We refer our readers to that authority for the details, which are too abstruse for abstraction in popular form, but give below for comparison the values ascertained by the several scientists who have investigated the subject. [These values are given in kilometers; to find their equivalent in miles, multiply the quantities by .62.]

Velocity of Light.

Foucault	298,000	kilometers.
Cornu	300,000	"
Perry and Ayrton	298,000	"
Michelson	299,820	"
Chase (1)	298,030	"
Chase (2)	299,090	"

Prof. Chase regards his second value as more accurate than the first.

Explosion of a Diamond.—At a recent meeting of the Academy of Natural Sciences of Philadelphia, Prof. Leidy exhibited a black agate sleeve button, which had set in it centrally, raised in a gold setting, a rose diamond, about 7 millimeters broad. It had been submitted to him by Mr. Kretzmar, a jeweler, who informed him that the person who wore it was recently leaning with his head upon his hand on a window ledge in the sun, when the diamond exploded audibly, and with sufficient force to drive a fragment into his hand and another into his forehead. On examining the diamond, the fractured surface, following a cleavage plane, exhibited apparently the remains of a thin cavity, such as is sometimes to be seen in quartz crystals. The fracture also exposed a conspicuous particle of coal. Prof. Leidy thought that the explosion had been due to the sudden expansion of some volatile liquid contained in the cavity, as frequently occurs in cavities in many minerals. Mr. Goldsmith thought it possible that the liquid was carbonic acid, as he was impressed with the idea that diamonds originated from this material in the liquid condition.

Quantity of Carbonic Acid in the Air.—Observations made daily during a period of four years in France, by MM. Lavy and Allaire, show that the quantity of carbonic acid gas in the air varies between 22 and 36 parts by volume in 100,000.

Improved 16-inch Weighted Engine Lathe.

In continuation of our several references of special machine tools manufactured by the Pratt & Whitney Company, of Hartford, Conn, we present in the following an illustrated description of their improved 16-inch weighted engine lathe, with screw and back gears, and of a special taper attachment with which this tool and others of the same type are provided.

The size of this lathe makes it suitable for general work. It swings 16 inches over the bed and 8 inches over the carriage. The spindles are of steel, the front bearing of the line spindle being 3⅛ inches long by 1¾ inches diameter. The boxes are of cast-iron, lined with best Babbitt metal. The cone is turned inside and outside, to balance it, and is driven by a belt 2¼ inches wide. With the usual set of gears, screws of from 3 to 48 threads to the inch may be cut. The counter-shaft is furnished with Pratt's patent friction clutch. When specially ordered, Slate's taper attachment is furnished with the lathe. (This last device is shown and described in detail further on).

The speed of the counter-shaft is 120 per minute. This size of lathe is also furnished to order with gibbed carriage; the gibbed lathe swings 10½ inches over the carriage. Large face plate, stationary and follow rests, wrenches, and counter-shaft are included in the following statement of dimensions and weights:

Length of bed.	*Distance bet. centers.*	*Weight without taper attachm't.*	*Weight with attachm't.*
5 ft.	2 ft. 5 in.	1,175 lbs.	1,215 lbs.
8 ft.	5 ft. 5 in.	1,400 lbs.	1,440 lbs.

The special attachment referred to in the foregoing description as "Slate's taper attachment," will be understood from the accompanying engraving (Fig. 2) and description. This device does not interfere with any of the common functions of the turning or screw-cutting lathe, and has certain positive advantages—namely, it is not necessary, when it is used, to place the lathe centers out of line; the varying length of the pieces used does not affect the taper; the degree of taper required can be accurately adjusted by a graduated scale on the attachment, thus obviating the necessity of preliminary or trial cuts; it is especially well adapted to turning tapering holes on chucked work, as on outside work; and can be readily released without removing any part of it from the lathe. The details will be understood more fully by reference to Fig. 2 and the following description: A represents an adjustable bar, supported on three brackets B on the back of the lathe, the center one receiving the pivot C, on which the bar swings, the two other brackets supporting the bar and guiding it by radial slots in their upper surfaces. Handle-nuts at each end, on the under side of the brackets, secure the bar in place. D is a thumb-screw for adjusting the bar; the slide E traverses a longitudinal slot in the bar, and to it is pivoted the nut-bar F, which slides in a groove in the lower part of the tool-carriage; G is a stop-screw used in turning outside, and H is a similar screw for adjusting the tool for inside work, as chucking, etc. When the bar A is placed at an angle with the ways of the lathe, it imparts a gradual transverse movement to the upper part of the tool-carriage, in or out from the centers, through the medium of the sliding nut-bar, thus giving the taper.

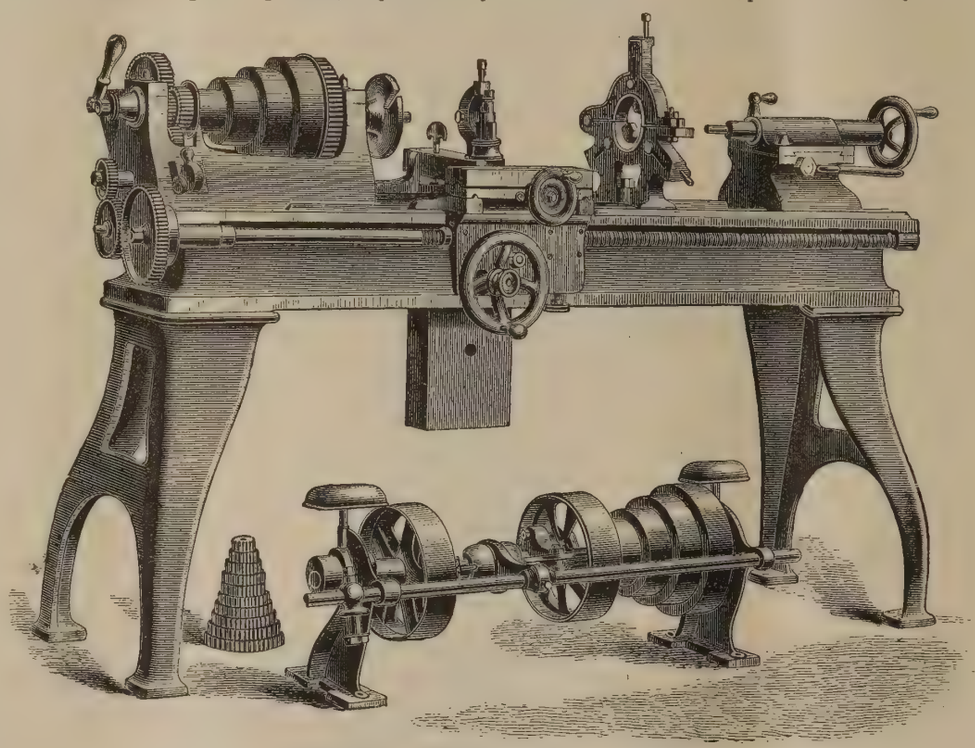


Fig. 1.—IMPROVED ENGINE LATHE.

Hints on the Use of Plaster of Paris.—The plaster may be made to "set" very quickly by mixing it in warm water to which a little sulphate of potash has been added. Plaster of Paris casts, soaked in melted paraffine, may be readily cut or turned in a lathe. They may be rendered very hard and tough by soaking them in warm glue size until thoroughly saturated, and allowing them to dry. Plaster of Paris mixed with equal parts of pumice stone makes a fine mold for casting fusible metals; the same mixture is useful for encasing articles to be soldered or brazed. Casts of plaster of Paris may be made to imitate fine bronzes by giving them two or three coats of shellac varnish, and dusting on fine bronze powder when the mastic varnish becomes sticky.

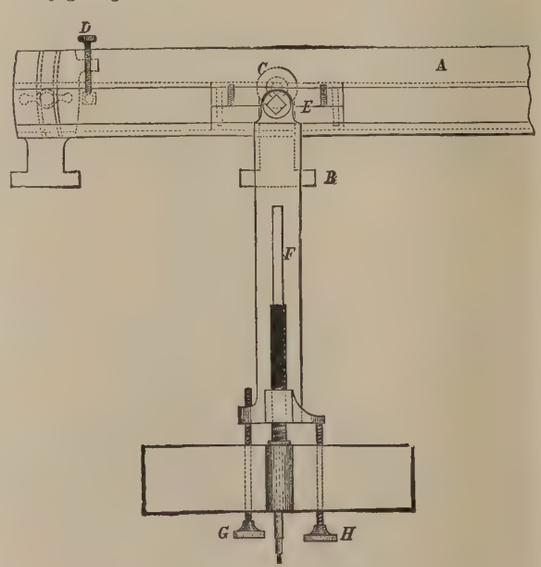


Fig. 2.—Taper Attachment.

Rat holes may be effectually stopped with broken glass and plaster of Paris.

A good method of mixing plaster of Paris is to sprinkle it into the water, using rather more water than is required; when the plaster settles, pour off the surplus water and stir carefully. Air bubbles are avoided in this way.

Petroleum as Blast Furnace Fuel.

An experiment in the use of petroleum as fuel in the blast furnace, is reported to have lately been made at the Fannie Furnace, in West Middlesex, Pa., after a process invented by Mr. R. S. Robertson, of Pittsburgh. The operation, as described—not very lucidly—by one of the local journals (*Sharpsville Advertiser*), consists in injecting crude petroleum into the furnace, along with the blast (hot) and superheated steam. The quantity of oil used is reported to be small when considered in the light of the results obtained, and the superheating of the steam is effected by utilizing the heat of the waste gases collected at the top of the furnace.

The chief advantage claimed by the inventor for his process, aside from the question of economy, (which is affirmed to be very considerable), is that all the objectionable impurities—phosphorus, sulphur, etc.—of the ore are eliminated in the furnace during the process, the result being a metal of very high quality. The inventor claims also that even if the cost of the iron by this process should far overrun the cost of that produced when the ordinary fuel is used, the gain in the quality of the product will more than compensate for the loss. It is furthermore claimed that a gain in time will result, thus increasing the capacity of a furnace using the process.

From the above very imperfect description of the process of Mr. Robertson, we are unable to glean any facts that would warrant the claims made in its behalf. We do not comprehend the *modus operandi* of the elimination of the impurities of the ore, as the philosophy of the reduction of the ore is precisely the same as when solid fuel is used; we can understand that the fuel (petroleum) itself being purer than the ash-bearing coal, would not impart any impurities to the metal, as is the case with coal; but where the "elimination" comes in we are unable at the present moment to understand.

We are led to infer from the context of the article from which the foregoing facts were taken, that petroleum was the *only* fuel employed—or at least that it is contemplated, in carrying out the process fully, to use nothing else. In this event there are questions of very grave import, both mechanical and chemical, to be answered before it can be affirmed to be possible to work the process. That a process substantially not unlike that of Mr. Robertson's could be operated, and possibly with advantage, in connection with the use of solid fuel in blast furnaces, *as at present constructed*, we think is not impossible; but if liquid or gaseous fuel is to be employed exclusively, experience will most probably demonstrate that essential modifications of the form of such furnaces will have to be made, to adapt them to the new conditions presented. Just how far Mr. Robertson's plan may have shown itself to be meritorious, cannot be decided from the above imperfect account, but any experiments in this direction are of interest.

Completion of the St. Gothard Tunnel.

A dispatch from Berne, Switzerland, announces the satisfactory completion of the work of piercing Mount St. Gothard, amid great rejoicing. The contract for the construction of the St. Gothard Tunnel was awarded to M. Louis Favre, of Geneva, on August 7, 1872. It was one of the conditions of the contract that the perforation should be completed within eight years from that date, with a large premium in case of the completion of the work in a shorter time, and with a not less heavy penalty in case of delay. It will be seen, therefore, that the contractor has kept inside of his limit by some months. His opinion that the perforation could be accomplished in a considerably less period would doubtless have been justified but for the fact that progress was frequently impeded by the caving in of the rock and by the irruption of water from fissures in the strata. Despite those difficulties, which were sometimes serious, and always great consumers of time, M. Favre has the satisfaction of having bored the longest tunnel in the world by over a mile in less time by over five years than was required to bore the Mont Cenis tunnel, now the second greatest work of the kind. This rapid achievement is a triumph for the improved drilling machinery of modern invention which has been employed upon the St. Gothard tunnel from the beginning. Comparison of the three largest tunnels show that the Mont Cenis, length eight miles, less a few yards, cost $15,000,000, was constructed in the thirteen years from 1857 to 1870; the Hoosac tunnel, length four and three-quarter miles, cost $13,000,000, was finished in eleven years from the time the work was properly begun; and the St. Gothard, length nine and one-quarter miles, has been bored in less than seven years and a half. The contract prices sum up to a total estimated cost of $9,700,000. This amount was to cover all expenses, whether direct or accessory, and all risks and contingencies from whatever cause arising. If this part of the contract is held to, the St. Gothard will be much the cheapest of the three tunnels in cost of construction, in addition to its other and sufficient distinctions.

The project of tunnelling Mount St. Gothard may be said to have grown out of the successful piercing of Mont Cenis. Until that work was accomplished, most of the travel and transport of merchandise between Italy and Switzerland, Northeastern France, Western and Central Germany, and Northern Europe, were accomplished over the Alpine passes, which had their northern termini in Switzerland. Thus, the three great carriage roads, the Simplon, the Splugen, and the St. Gothard, monopolized by far the larger part of the transit, though other less notable passes, and particularly that of Mont Cenis, maintained an active competition. The opening of the Mont Cenis tunnel, in 1870, put an end to the profitable monopoly of the Swiss highways, and was a serious blow to both Italy and Switzerland. The fact was recognized at once that something must be done to open a new and direct railway route across the Alps. The first proposal was to follow the line of the Simplon road, and not only was a company formed, but the work of grading was begun in accordance with that plan. It became evident, however, that the Simplon route would not accomplish what Italy and Switzerland desired, since it would be, like the Mont Cenis road, directly tributary to the interests of France. That project was abandoned, and the choice then lay between the Splugen and St. Gothard routes. The former required a tunnel of only four miles in length, and was much favored on that account; but the fatal objection was that, like the Simplon road, it must pass down the valley of the Upper Rhine and along the Austrian frontier, hence being liable to interruption and control by a hostile force in the event of European complications from which Switzerland should not be able to keep free as a neutral. The St. Gothard route had a nine-mile tunnel to be bored, but it had the advantage, chief of all in the interest of the countries which proposed to construct it, of beginning in the very heart of the Swiss confederacy, passing wholly on Swiss soil, far removed from the eastern and western frontiers, to Lago Maggiore and the Lake of Lugano, where connections would be made with the Italian lines and the port of Genoa.

For these reasons the St. Gothard line was adopted, and in 1871 the Swiss, Italian, and German Governments concluded a treaty, determining the points relative to route, constructions, and connections. Among the stipulations were the following: That the summit level of the line should not be at greater hight than 1,162½ meters above the sea, and that the tunnel should follow a straight line between Airolo and Goscheuen; the shortest radius of the curves was fixed at 300 meters, and the maximum of the greatest not to exceed 32 feet to the mile, except for a short distance near Biasca. The three contracting Powers agreed to contribute to the enterprise 85,000,000 francs, as follows; Italy, 45,000,000; Switzerland, 20,000,000; Germany, 20,000,000. The Italian and Swiss railway companies held a conference, a company was organized, and in 1872, as stated, M. Favre was the successful bidder among those who proposed to undertake the construction. In the fall of 1872, the plans and preparations having been completed, the actual work was begun. The cross-section of the St. Gothard is the same as that of the Frejus or Mont Cenis tunnel, and the same technical methods of excavation were followed. The engineer possessed several advantages, however, over the engineer of the Mont Cenis line. He had the experience of that great work as a guide, improved and tested machinery from the start, whereas machinery was not employed in the Mont Cenis at all until the fifth year of the construction, and the use of dynamite and other explosives not known until the Mont Cenis was far advanced. It was possible, moreover, to sink a considerable number of shafts along the line of the St. Gothard in case this became necessary, but the occasion did not arise. Very little hand labor was employed; almost none after the first two years. The Dubois-Francois perforators were first used, making an average advance of 6.63 lineal feet per day. They were succeeded by Ferroux's, and the daily advance was increased to 10.11 feet. Then the machines of two or three inventors were placed and worked together on the same carriage, to test their capacity. By this means the utmost of advance possible was secured, and experimental results were obtained which will be of great value in further enterprises of tunnelling. It is estimated that revetement was necessary for about half the length of the tunnel. The difficulties in the way of caving and of water irruptions were much greater than were met with in the prosecution of work on the Mont Cenis route, which was specially free from springs. Up to January 1, 1877, the heading of the St. Gothard, which was driven at the top about eight feet square, had been carried 18,238 feet, and it was then predicted that the tunnel would be completed in the summer of 1879.

The total length of the tunnel proper is 14,920 meters. The line of the tunnel leaves the St. Gothard carriage road to the left at Airolo, passes northwest under the Kastelhorn, 2,977 meters high; the St. Anna glacier, the village of Andermatt, the river Reuss about at the Devil's Bridge, and comes out at Goschenen, at the level of that village and the carriage road. At the southern end is a curve of junction 145 meters in length; but, as in the case of the Mont Cenis, a straight gallery is excavated through the mountain from terminus to terminus. The station at Airolo is 1,145 meters above the sea. From this point the grade ascends at the rate of 1-1000th, 7,400 meters; then follows the summit level of 180 meters at the hight of 1,152.4 meters, or 10 meters lower than the highest limit allowed by the contract; then a descending grade of 5.82-1000, 7,457 meters, to the northern station at Goschenen, 1,109 meters above the sea. The St. Gothard Railway will form the shortest line of transit between the valley of the Rhine and the Mediterranean, and it has been well said that when the geographical relations of the countries it serves to connect are considered, together with the vast political, military and commercial interests which will be affected by it, it may safely be characterized as the great artery of European international life and circulation, and as the most important work of material improvement yet projected on that continent.

A Belgian Prize for the Improvement of Harbors on Low and Sandy Coasts.

The United States Commissioner of Education has just issued an official circular, inviting the attention of scientists, engineers and others to the fact that the yearly prize of 25,000 francs, offered by his Majesty the King of the Belgians, for the encouragement of intellectual effort, will be granted in 1881 to the author of the best monograph on the means of improving ports established on low and sandy coasts, like those of Belgium. This prize is open for international competition; and the fact that our own Atlantic coast presents many points of similarity to that of Belgium, renders the announcement additionally interesting to American engineers. We reproduce herewith the official copy of the announcement, transmitted to the Secretary of State from the Belgian Legation:

"By a decree of December 14, 1874, His Majesty the King of the Belgians offered an annual prize of 25,000 francs for the encouragement of intellectual effort. The prize for the year 1881, for which authors of all nations may compete, will be awarded to the best work on the means of improving ports established on low and sandy coasts like those of Belgium. Foreigners desiring to compete for this prize will be required to send their works, either printed or in manuscript, to the Minister of the Interior at Brussels, before the 1st day of January, 1881. A manuscript work obtaining the prize must be published in the course of the year following that in which the prize shall have been awarded. The award will be made by a jury appointed by His Majesty the King of the Belgians; this jury will be composed of seven members, three of whom are to be Belgians and four foreigners of different nationalities."

A Sword Forged from a Meteor.

There is now in the museum at the City of Mexico, a remarkable sword, made from an ærolite or meteor that fell in the State of Durango, Mexico. A Mexican gentleman sent to General Ord, of the United States Army, a small slab or tablet, about an inch thick and six inches square, which was sawed out of the meteor. It resembled iron, and, in fact, was what is known as meteoric iron. The piece weighed two pounds. Gen Ord sent it on to the national armory at Springfield, to be worked up into a sword for Gen. Trevino, of the Mexican Army, who has done so much to rid our border of the Indians that infested it. Considerable trouble was experienced in annealing the meteoric iron, but at last they succeeded, and, with the scabbard, it forms a very creditable specimen of American skill. The sword is a small, straight blade, and is a fancy-dress sword, the mounting representing an eagle with the olive branch and arrows, such as we see on a quarter of a dollar now and then. The grip is of silver wire, and the whole thing is very pretty. On the blade is the Spanish sentence, which, translated into English, reads: "Made of iron that fell from the skies of Mexico. Presented to G. Trevino, General of Division, by his friend, Gen. Ord, U. S. A."

Tarring Ropes, it has been shown, slightly diminishes their tenacity against a pulling strain—but maintains a high average of tenacity much longer than an untarred one, by reason of the protection the tar affords against atmospheric and other causes of deterioration. The quantity of tar found most suitable is about 15 per cent of the weight of the rope.

Rifle-Ball Problem.—An interesting communication from A. T. G., of Buffalo, N. Y.; in reference to the rifle-ball problem in our department of "Notes and Queries" for February, will receive attention in our next issue.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$60 00 *a* — —
Pine, good	50 00 *a* 55 00
Pine, shipping box	18 00 *a* 22 00
Pine, common box	17 00 *a* 18 00
Pine, common box, ⅝	15 00 *a* 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	40 *a* — —
Pine, tally plank, 1¼, 2d quality	35 *a* 38
Pine, tally plank, 1¼, culls	28 *a* 30
Pine, tally boards, dressed, good	28 *a* 30
Pine, tally boards, dressed, common	22 *a* 25
Pine, tally boards, culls, dressed	22 *a* 25
Pine, strip boards, merchantable	16 *a* 18
Pine, strip boards, clear	22 *a* 25
Pine, strip plank, dressed, clear	33 *a* 35
Spruce boards, dressed	20 *a* 22
Spruce plank, 1¼-inch, dressed	25 *a* 28
Spruce plank, 2-inch	40 *a* — —
Spruce wall strips	13 *a* — 15
Spruce timber, per M	18 00 *a* 22 00
Hemlock boards, per M	15 00 *a* 16 00
Hemlock joist, 2½x4, each	15 *a* — 16
Hemlock joist, 3x4	16 *a* — 18
Hemlock joist, 4x6	40 *a* — 44
Ash, good, per M	40 00 *a* 45 00
Oak	50 00 *a* 55 00
Maple culls	25 00 *a* 30 00
Maple good	45 00 *a* 50 00
Chestnut	45 00 *a* 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 *a* 40 00
Black walnut, good to choice	85 00 *a* 100 00
Black walnut, ⅝-inch	75 00 *a* 85 00
Black walnut, selected and seasoned	110 00 *a* 150 00
Black walnut counters, per ft	12½ *a* 20
Cherry, wide, per M	85 00 *a* 100 00
Cherry, ordinary	60 00 *a* 80 00
White wood, inch	45 00 *a* 50 00
White wood, ⅝-inch	30 00 *a* 35 00
White wood, ⅝ panels	35 00 *a* 40 00
Shingles, extra sawed pine, 18-inch	4 00 *a* 5 00
Shingles, clear sawed pine, 16-inch	3 75 *a* 4 00
Shingles, cypress, 24x6	18 00 *a* 21 00
Shingles, cypress, 20x6	10 00 *a* 12 00
Lath, Cargo rate	2 75 *a* — —
Yellow dressed pine flooring	25 00 *a* 30 00
Yellow pine girders	30 00 *a* 40 00
Locust posts, 8 feet, per inch	18 *a* 20
Locust posts, 10 feet	24 *a* 25
Locust posts, 12 feet	29 *a* 34
Chestnut posts, per ft	3 *a* 3½
Basswood per M	25 00 *a* 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	7 50 *a*	8 00
Up Rivers	— — *a*	— —
Jersey	9 50 *a*	9 75
Long Island	10 00 *a*	10 25
Haverstraw Bay	10 00 *a*	10 25
" " choice	10 25 *a*	10 50
Favorite Brands	— — *a*	— —
Hollow Fire-Clay Brick	12 50 *a*	— —

FRONTS.

Croton—Brown, per M.	11 00 *a* — —
" Dark	12 00 *a* — —
" Red	13 00 *a* — —
Philadelphia	20 00 *a* — —
Trenton	20 00 *a* — —
Baltimore	38 00 *a* — —
Clark's Ottawa White	25 00 *a* — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1¼c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	33 50 *a* 34 50
" Glengarnock	32 00 *a* 32 50
" Eglinton	31 00 *a* 31 50
" American, No. 1	40 00 *a* — —
" American, No. 2	38 00 *a* 39 00
" American, forge	37 50 *a* 38 00

	Store prices. Cash.
Bar, Swedes, ordinary sizes	— 6 *a* — 6¼
Bar, Swedes, nail-rod	— 6½ *a* — —

LEAD—PER 100 POUNDS.

*German	— — *a* — —
*English, common	— — *a* — —
*Spanish	— — *a* — —
*Foreign, refined	— — *a* — —
*Bar	7 00 *a* — —
*Sheet	8 00 *a* — —
*Pipe	7 50 *a* — —
*Domestic	5 50 *a* 5 63½

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 70 *a* — —
8d and 9d, common	3 95 *a* — —
6d and 7d, common	4 20 *a* — —
4d and 5d, common	4 45 *a* — —
3d and 4d, light	5 20 *a* — —
3d, fine	5 95 *a* — —
2d, fine	5 95 *a* — —
Cut spikes, all sizes	4 95 *a* — —
Clinch nails, 1½ to 1¾ inch	5 95 *a* 6 20
do. 2 to 2¼ inch	5 70 *a* — —
do. 2½ to 2¾ inch	5 45 *a* — —
do. 3 inch and longer	5 20 *a* — —

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	10 00 *a* 10 25
*I. C. coke, 10x14	8 25 *a* 9 50
*I. X. charcoal, 10x14	12 00 *a* 12 25
*I. C. charcoal, 14x20	10 10 *a* 10 25
*I. X. charcoal, 14x20	12 00 *a* 12 25
*I. C. coke, 14x20	8 25 *a* 9 50
*I. C. coke, terne, 14x20	8 50 *a* 8 75
*I. C. charcoal, terne, 14x20	9 00 *a* 9 50

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 8⅜ *a* — 8½
Sheet, (open)	— 9 *a* — 9½

SOLDERS.

No. 1	— 14½ *a* — 15
No. 2	— 13½ *a* — 14

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 90 *a* — 95
Berlin Freestone, in rough	— 95 *a* — —
Berea Freestone, in rough	— 80 *a* — —
Brown-Stone, Portland, Conn	1 05 *a* 1 30
Brown Stone, Belleville, N. J	1 25 *a* 1 75
Granite, rough	— 75 *a* 1 00
Canaan Marble	1 25 *a* 1 50
Dorchester, N.B., Stone, rough, per foot	— — *a* 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 *a* 7 25
Chalk, per 100 lbs	— 35 *a* — —
China Clay, per ton gold	18 00 *a* 20 00
Chrome yellow, dry, per pound	— 12½ *a* — 28
Lead, red American, per pound	— 8 *a* — 9
Lead, white American, pure, in oil	— 9 *a* — 9½
Lead, white American, pure, dry	— 8¾ *a* — 8¾
Lead, white English, pure, in oil gold	— 9½ *a* — 10½
Litharge	— 7½ *a* — 8
*Ochre, Fr., dry, per 100 lbs	1 50 *a* — —
Ochre, ground, in oil, per lb	— 6 *a* — 15
Ochre, Vermont, per 100 lbs	— 75 *a* 1 00
*Orange Mineral, English gold	— 9½ *a* — 10
Paris White, American	— 1½ *a* — 1¾
Paris White, English, prime	— 2 *a* — 2¼
Paris Green	— 15 *a* — 28
Plumbago paint, patent, per lb	— — *a* — 25
Putty, per lb	— 2½ *a* — 3
Spanish Brown, dry, per lb	— 1⅜ *a* — 1¼
Spanish Brown, ground in oil, per lb	— 8 *a* — 9
Venetian red, per cwt	1 75 *a* 2 00
*Vermilion, Chinese, per lb	— 85 *a* — 90
*Vermilion, Trieste	— 70 *a* — 75
*Vermilion, quicksilver, bags gold	— 60 *a* — 62½
Vermilion, American, common	— 15 *a* — 18
Whiting, per 100 lbs	— 60 *a* — 80
Zinc, white American, dry, No. 1	— 5 *a* — 7½
Zinc, white American, No. 1, in oil	— 8 *a* — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¼ *a* — 9
Zinc, white French, in oil gold	— 10 *a* — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 *a* 4 00
Coach Body	2 35 *a* 3 50
do do	1 80 *a* 2 00
Furniture	1 25 *a* 2 50
Black Asphaltum	1 00 *a* 1 50
Brown Japan	1 00 *a* 1 20
Liquid Paint Dryer	1 35 *a* 1 75
Harness, (black)	3 00 *a* 4 50
Shellac, Spirits	3 00 *a* 3 50

CEMENT—PER BARREL.

Portland (imported)	2 95 *a* 3 50
Portland (American)	2 65 *a* 3 00
Portland (Spanish)	2 50 *a* 2 75
Portland (Lafarge)	3 20 *a* 3 40
Portland (German, Bonner)	3 00 *a* 3 25
Lime of Teil	2 20 *a* 2 30
Lime of Teil, per ton	15 00 *a* 18 00
Roman	3 00 *a* 3 25
Keene's & Martin's, coarse	6 00 *a* 6 50
" fine	10 50 *a* — —
Rosendale	1 25 *a* 1 30

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb.	— 1¼ *a* — 1½

HAIR.

Cattle, per bushel of 7 lbs.	— 11 *a* — 14
Goat, " "	— 13½ *a* — 17

SLATE.

Purple roofing slate, per square	$6 00 *a* 7 00
Green slate	7 00 *a* — —
Red slate	10 00 *a* 11 00
Black slate, Pennsylvania, (at Jersey City)	4 00 *a* 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 *a* — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	— — *a* — —
Nova Scotia, blue	— — *a* — —
Calcined, Eastern and city, per bbl	1 25 *a* 1 40
Calcined, city casting	1 45 *a* 1 50
Calcined, city superfine	1 55 *a* 1 75

LIME—PER BARREL.

State, common	1 00 *a* 1 25
" finishing	— 90 *a* — —
Rockland, common, cargo rate	1 00 *a* — —
" finishing	1 25 *a* — —
Ground	1 00 *a* — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 20 *a* — 35
St. Domingo, crotches, fine	— 25 *a* — 50
St. Domingo, logs, small	— 5 *a* — 8
St. Domingo, logs, large	— 20 *a* — 30
Frontera, Mexican, large	— 11½ *a* — 16
Frontera, Mexican, small	— 8 *a* — 10
Other Mexican	— 8 *a* — 14
Honduras	— 10 *a* — 15

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ *a* — 6
Rio Janeiro, good to fine	— 5 *a* — 8
Bahia, ordinary to good	— 2 *a* — 6½
Bahia, good to fine	— 4½ *a* — 8
Honduras, per ton	10 00 *a* 20 00
Satin Wood, per foot	— 15 *a* — 60
Tulipwood, per lb	— 6 *a* — 12½
Lignumvitæ, small, per ton	10 00 *a* 20 00
Lignumvitæ, large	25 00 *a* 50 00

CEDAR.

Cuba, per superficial foot	— 10 *a* — 12½
Mexican, small	— 8 *a* — 10
Mexican, large	— 10 *a* — 14
Florida	— 30 *a* 1 50

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¼ inch.	$ 84 —
2.6 x 6.6	1¼	1 18 —
2.6 x 6.8	1¼	1 24 —
2.8 x 6.8	1¼	1 30 —

DOORS, MOLDED.

Size.	1¼ inches.	1½ inches.	1¾ inches.
2.0 x 6.0	$1 54	—	—
2.6 x 6.6	1 90	2 41	—
2.6 x 6.8	1 96	2 43	—
2.6 x 6.10	1 98	2 51	—
2.6 x 7.0	2 02	2 61	—
2.8 x 6.8	2 02	2 61	3 20
2.8 x 7.0	2 11	2 71	3 36
2.10 x 6.10	2 23	2 82	3 55
3.0 x 7.0	2 33	3 06	3 75

OUTSIDE BLINDS.

Up to 2.10 wide, per lineal foot	25 *a* —
Up to 3.1 wide	27 *a* —
Up to 3.4 wide	30 *a* —

GENERAL REVIEW OF THE MARKETS.—Every indication that has been shown in the markets during the past month, has promised a brilliant opening for the spring trade, and the tone has been strong and cheerful throughout. Building continues active, and we hear of some large operations that are about to be commenced. With the exception of brick, for which prices have shown a somewhat undue development, the markets have continued to show a steady, healthful improvement.

THE MARKETS IN DETAIL.—In the brick market the past month prices have been very buoyant, and the suddenness of the rise, together with the absence of any special reason therefor, would seem to indicate an abnormal stimulus, and we think it safe to predict an early drop to more natural limits. At present, however, the situation is very strong, and so long as supply and demand stand in their present attitude toward each other, full prices must naturally be sustained; but it may be accepted as a certainty that as soon as adverse influences are removed the offering will increase from such supplies as may be left on the hands of manufacturers, and it is intimated that unless prices go off very materially, some of the stock now at primary points under control of city holders will be thrown upon the market.

In the lumber market the demand has been very full, but buyers generally have moved with caution, and have rarely negotiated except in cases where they were compelled to secure supplies to carry out contracts already in hand. The liberal addition made to values has in a manner contributed to this result, while the near approach of a season when the opportunities for reaching a larger amount of supplies must rapidly increase, has not been without effect.

In the lime market a strong, cheerful tone has been shown, and demand has been sufficiently full to exhaust everything offering.

In the lath market the situation has been firm.

In the cement market demand for both domestic and foreign brands has been good, with buyers readily submitting to the rates asked, and sellers talking of still higher figures.

In the hardware market business has been brisk, and has encouraged the belief of a large spring trade. Factories have been kept busy to their full capacity, and full prices have been maintained without any difficulty whatever, and additions to cost may be expected at any moment.

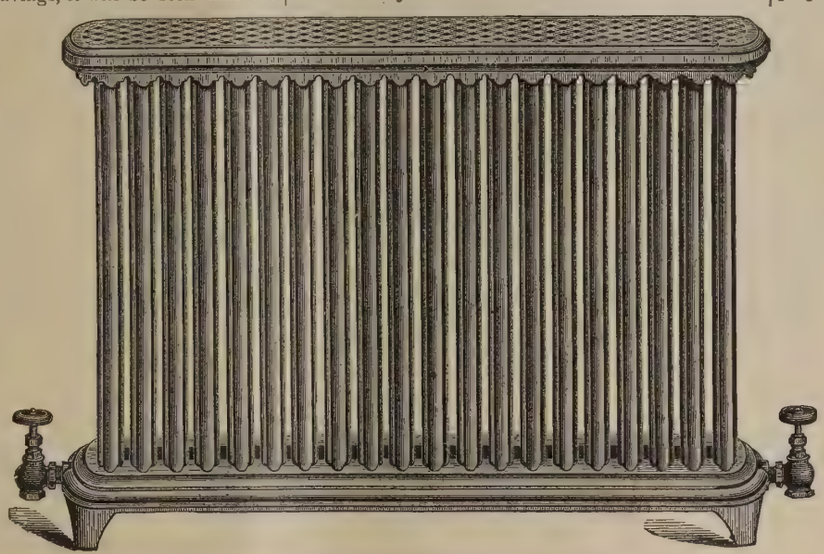
In the metal markets prices have weakened to some extent. American pig has been quiet, buyers standing off to await the issue on what appears to be a weakening tendency. We note a recent decline of from $3 to $4 per ton. Manufactured iron has sold with much freedom; the supply has been small and the market well maintained on all kinds. Scotch pig has shown a weak, unsettled tone, and our prices are shaded a trifle from last month's figures. Domestic pig lead has sold to about the average extent, with former prices obtained and the market firm, but plenty of stock offered for the outlet. Pig tin has favored the buyer, and a fair amount of stock was offered, but without attracting increased demand from any quarter. Tin plates have been in light, uncertain demand. Sheet zinc has been in fair demand, and steady.

In the paint markets a good business has been done, and the tone is healthy and cheerful.

Home Department.

Reed's Improved Radiator.

The apparatus shown in longitudinal and end views in the accompanying illustrations, is presented to our notice with high encomiums in behalf of its simplicity of construction and effectiveness of action. It is of the vertical tube pattern, designed for high and low pressures, and is known as "Reed's improved cast-iron radiator." The form of the tubes employed is that of a flattened ellipse, with an enlargement or corrugation along its sides—a form which increases the amount of radiating surface as compared with the area of the tubes, and at the same time permits of their compact disposition. The manufacturers claim for their apparatus in this respect that "the shape of the tube is such as to give a larger proportion of radiating surface to the volume of steam required to fill the radiator, than any other in the market." In the attachment of the tubes to the base, the use of screw joints is obviated; the tubes are expanded into the base by hydraulic pressure, using a copper ring or washer in each joint. The makers invite special attention to the coupling of the tubes in series, in relation to the base. From an inspection of the engravings, it will be seen that the base is constructed with an opening extending the whole length of the tubes, an arrangement, which, by rendering the interior surfaces of the tubes accessible to the air, and offering no hindrances to its free circulation, permits every part of the radiator to become an effective heating surface. An inspection of the form and arrangement of the tubes will make it apparent that the apparatus, while it offers a large surface for heating by convection and radiation, is at the same time very economical of space. The absence of any appearance of joints, from the mode of putting it together, adds decidedly to its attractiveness, and the accessibility of all its parts, before alluded to, allows it to be easily kept free from the accumulation of dirt. Every radiator is tested at a pressure of 125 pounds to the square inch, and is warranted by the manufacturers to stand a pressure of 60 pounds.



Side View. *REED'S DIRECT RADIATOR.*

End View.

It is hardly necessary to add that the line of tubes is secured firmly above by the use of a through-bolt; that several sets may be used when desired, by attaching them to a double base, and where the apparatus is wanted to be used for indirect heating, it can be suitably enclosed with an apron provided for the purpose. The apparatus, as a whole, seems to possess the merits of simplicity and effectiveness, and enjoys a wide and desirable patronage, being in highly successful use in many buildings in the United States, both public and private, including the State Capitols at Albany and Hartford.

The makers are the H. B. Smith Co., of No. 8 Dey street, New York, who may be addressed for further information.

Ill-Health Among Woman.

The *Sanitary Engineer* has the following references to an excellent paper by Miss Anita E. Tyng, M. D., of Providence, on "the Causes of Ill-Health among Women," contributed to the annual report of the Rhode Island State Board of Health, which deserves republication as a sanitary tract. She places ignorance as among the chief of these evil causes, and suggests that one remedy lies in the dissemination of proper knowledge by sanitary authorities. Instruction is needed in the duties of motherhood and in scientific cooking, especially the preparing of proper nourishment for the sick. She thinks there is room for the better organization of household labor, and that if we had women architects much improvement might follow in the arrangement of houses. If the masses were properly taught to abandon their "half-starving diet" of bread and tea, and excessive use of patent tonic medicines, much good would result. She quotes authorities to prove that as a rule people are under-fed, and that the use of stimulants and the consequent physical and moral degradation, can and should be prevented. It is easy, she remarks, to be a good Christian if one has a sound spine and a sound stomach; so it is easy, if one has a sound stomach well supplied, to resist the temptations of liquor and to refrain from crime. It is said that insanity is on the increase, especially among the ignorant classes, and that only ten per cent are cured, yet Dr. Tyng cites numerous authorities to show that mental disease may be greatly diminished by a more rigid observance of the laws of health and nature. The delicate subjects of abortion and the social evil are discussed by Dr. Tyng in a practical manner, and her suggestions are pertinent. Popular enlightenment, she thinks, will lessen both these evils. A change of tone in public opinion is needed. Delicacy must not be confounded with refinement, nor thinness and paleness admired for beauty. Sickness should be considered as allied with sin. Finally, women must be taught to help themselves in these matters. We trust these wise suggestions will find many readers.

Cubic Capacity of the Skull.

Of the several modes of measurement by which the difference can be determined between the human skulls of one race and another, the most important is now believed to be that which gives the cubic capacity of the great cavity of the skull wherein the brain is contained. Upon this basis, some interesting investigations have been made. Among other facts ascertained is that relating to a race of long, flat-headed people on the west coast of Africa, who exhibit the largest average capacity of any human heads yet examined. The Laplanders and Esquimaux, though a very small people, have very large skulls, the latter giving an average measurement of 1,546. The lower grades of English skulls show a size or capacity of 1,542; the inhabitants of the Canary Islands, 1,498; the Japanese, 1,486; the Chinese, 1,424; the Italian, 1,475; the ancient Egyptians, 1,464; the true Polynesians, 1,454; negroes of various kinds, 1,377; the Kaffirs, 1,348; Hindoos, 1,306. The Australian aborigines give one of the smallest averages, namely, 1,283; and the Andamanese, a very diminutive people, show only 1,220. A comparison between the skulls of sixty-three men of various races, and of twenty-four women, showed the ratio of the woman's skull to the man's to be as 854 to 1,000.

Effect of Gas on Book-Bindings.

One of the many reasons for looking with favor upon the introduction of the electric light, is the belief that it will have no injurious effects on pictures, frames and book-bindings. Gas has always been supposed to destroy book leather; but, in a recent letter to a contemporary, Prof. Wolcott Gibbs, of Harvard University, says: "Some time since I made an examination of the bindings of books in the Public Library, supposed to be injured by the products of the combustion of coal gas. I arrived at the conclusion that there was not sufficient evidence to show that such was the case. I have since made a careful examination of books in the Athenæum, College and Astor libraries, and have found precisely the same state of things. You are aware that gas has never been used in the College and Astor libraries at all, and that in that of the Boston Athenæum gas is largely used in the reading-room, but not in the library proper. I found in each a large number of old books bound in calf, which presented the same appearance as those which I saw in the Public Library. These were all old books, and all bound in calf. Mr. Wilson, binder to Little & Brown, and a man of large experience, told me that the trouble was in the tanning of the leather, and not in the action of the gas—the older kinds of leather used by binders being of poor quality and badly tanned. I analyzed a number of samples of the leather in my laboratory, and found no free acid whatever. On the whole, therefore, I see no reason to change my opinion in the matter."

Moist Air Not Healthful in Dwellings.—Robt. Briggs, the well-known engineer, maintains the theory that the summer condition of temperature, 62° to 68°, and relative humidity, 80 to 85 per cent, is not desirable or attainable, at other seasons, in the heating of dwellings. His argument is, that the dry air of America possesses both curative and preventive qualities, of great value, and that moist air, which promotes vegetable growth, is, on sanitary grounds, not desirable for breathing. He states that the dew point is far below the freezing point of water in well warmed and ventilated rooms, where there is nothing of that sensation of dryness which is usually held to accompany the heat of a furnace, when not supplied with water for evaporation. Again, new houses, that are accounted unhealthy in Europe, are not so in America, and gas burned in rooms produces much less unpleasant effects in America than in England. His views on this subject are fully set forth in the *Journal of the Franklin Institute.*

Disinfectant for the Breath, etc.—A very weak solution of permanganate of potash is an excellent disinfectant for light purposes, such as rinsing spittoons, neutralizing the taint of diseased roots of teeth, cleansing the feet, and keeping the breath from the odor of tobacco smoke. [While the above statements are strictly correct, we feel called upon to state that the

permanganate of potassa is altogether too expensive to use for the purposes above-named. A very diluted solution (1 to 2 per cent) of chloride of zinc will answer quite as well as the permanganate, and costs almost nothing in comparison.—*Ed. M. & B.*

The Lay of the Demon Plumber.

The following lay appeared recently in one of the London papers. Plumbers, as well as their patrons, we have no doubt, will derive considerable amusement from the caricature:

It's ho! and oho! for the jolly Jack Frost,
And the pranks he plays up, to my customers' cost!
'Tis a precious ill wind as blows nobody good,
And a nipping north-easter is most to *my* mood;
When it freezes the cisterns and plugs up the pipes,
Oh, I laughs till the tears from my hoptics I wipes;
For it's followed in course by the loveliest thaw,
And then there's such havoc as never you saw;
For the men and the servint maids comes all a-blow,
From a'most every house in a'most every row,
Crying, "Come, Mr. Plumber—immejit—you *must!*
For the cistern is leaking, the pipes is all bust!
The water's all spouting, and running to waste;
We are reg'lar swamped out—do, for gracious, make haste!"
They all sing the same song, but I dordles along;
To expect *me* to 'urry *is* coming it strong!
And when I arrives, oh! the blokes and their wives,
And the slaveys nigh worritted out of their lives!
Such larks! There's the water all squashin' and squirtin',
And tricklin' and streamin', and spoutin' and spirtin',
And everythink dancin', and drenchin', and dirtin',
Spilin' ceilin's and walls, and the guv'nor's front-shirtin',
As he tries to stop wents, his white knuckles much 'urtin',
Which makes him use languidge—oh, ain't it diwertin'!
Then the mean uns, as, bent upon saving a mag,
Tries botchin' the 'oles up with putty and rag!
Don't I drench *them* to rights! Don't I tip it 'em stiff!
Ain't it scrumptious to watch 'ow they boggle and sniff!
Oh, I *do* hate a stingy and meddlin' old messer!
Then I outs with my tools, with my shaveback and dresser,
My turnpin and egg-iron, solder and soil,
My taller and rosin, and white lead and oil:
('Arf on 'em's no use, but they makes a good show,
And with green uns that's just 'arf the fight, don't yer know.)
Then I turns up the carpets and ile-cloths all round;
Tramps up and down stairs with a thunderin' sound;
And I arsks for a fire, and I 'ints for some beer,
And I kicks up a stink as makes Missis turn queer.
If they "part," wy I cock my heye knowing and chat;
If they don't, I turn sulky and swear at the cat—
Which *she* always comes sniffing and goes on the scare—
If they 'urries, I tells 'em to keep on their 'air;
For a job such as this is a thing as takes time.
Wy not? Easy does it, and fudgin's no crime.
Then, when they're well soaked, worried out of their wits,
And the fire nigh poked out with my irons and bits,
When the fumes of my solder has got in their eyes,
When I've sp'iled a few gimcracks with lampblack and size,
Dropped taller in lumps on the floor here and there,
And broken the back or seat of a chair,
Broke three or four bells, or maybe 'arf a dozen,
When everyone's grubby and cross and 'arf frozen,
Wy I manages somehow to take up a jint—
If they think it's a laster, it *may* disappint,
'Cos we've got to make hay while the sun shines, yer know,
Leastways, pile the dibs while there's frost, ice and snow.
There is lots more a-waiting, I sarves them the same,
And so, smart and lively, I keeps up the game.
Other trades may spout strong 'bout the beauties o' summer,
But a jolly 'ard winter's the time for the plumber!

Miscellaneous and Advertising.

The George Place Machinery Agency, of 121 Chambers and 103 Reade streets, this city, have always on hand a large line of new and second-hand machinery.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

We hear constantly very favorable reports regarding the "Usudurian" packing introduced and sold by the Woonsocket Rubber Co., of 80 and 82 Reade street, New York. Steam-users who have given it the most thorough trials, have in all cases adopted it, being convinced of its great efficiency.

One of the most important improvements for builders has been made by Mr. Frank Lyons, of 14 Center street, this city. We refer to his portable balanced derrick, which can be run back and forth, and turned on its center at any point, thus saving a vast amount of trouble that was experienced with the old-time derrick.

The Telegraph Supply Company, of Cleveland, Ohio, are working night and day, with a hundred men, exclusively running on Brush electric light apparatus, of which they are the sole manufacturers. They have orders on hand for months ahead, and up to this date have sold over fifteen hundred lights. They have made great additions to their manufacturing facilities, and now have one of the best machine shops in the West.

The extending use of wrought-iron beams and girders in the construction of buildings, is due to a great extent to the houses which have brought the cost of these fire-proof materials down to a reasonable basis, so that the difference now existing between wood and iron for such purposes is very slight. One of the establishments to which we have reference, and to whom the credit for what we have noted largely belongs, is the well-known firm of Carnegie Brothers & Co., of Pittsburgh, Pa.

Messrs. Goodell & Waters, of Philadelphia, are very busy at their extensive works in filling orders for their various manufactures. These latter include almost every kind of machine used by wood-workers, this enterprising firm making machines for planing mills, railroad shops, car-builders, cabinet, carriage, sash, door and blind makers. They have been increasing their facilities until they have now one of the most complete establishments for the manufacture of wood-working machinery in the country. Their works are at the corner of 31st and Chestnut streets.

The necessity of the modern time-detector is realized daily by the owners of the many stores, manufactories, warehouses and other establishments, and the result is that their employment has become very extended. There are, however, many buildings not furnished with them that should be, the owners not having thus far been taught by experience their great value; but delay is dangerous, and we would recommend those not already provided with this useful instrument to furnish themselves with it. One of the best in the market is that manufactured by J. E. Buerk, 230 Washington street, Boston.

Imported Cement, Fire Brick, Fire Clay Goods and Felt.

Amongst the articles of foreign production that have thus far continued to be steadily in demand, but which are now more so than ever before, because of the recent stimulation of building enterprise are certain standard brands of imported cements, fire bricks, and other fire clay goods and felt. In these lines of production our own manufacturers have not only been unable thus far to meet the extensive demand for such products, but they have likewise been unable to secure that uniformity of product which has enabled leading manufacturers abroad to establish standard brands of acknowledged value everywhere.

Of the standard goods of this nature that find their way to the American market, we may name Brooks, Shoobridge & Co.'s best English Portland Cement, the manufacturers of Calderwood, Orchard, Thornmuir, and other brands of Scotch Roman cement; Govan, "Star-Glenboig" & Craig's Scotch, and the famous Dinas Welsh fire bricks, and other goods of fire clay; also Anderson's English house roofing lining and ship sheathing felt.

With regard to the goods specified above, it may be remarked that the Portland cement made by Brooks, Shoobridge & Co. has for a number of years, by its superior quality, taken a prominent place in other countries as well as America for concrete buildings, stucco work, foundations, pier, bridge and harbor works, and also for lining iron ships; and all over Europe, the United States, Canada, South America, the East and West Indies, China and Japan, it is one of the standard brands. Its tensile strength ranges up to over 1,000 pounds on the 2¼ inches square. The following letter in regard to it will be of interest to architects and builders, and is good testimony as to its first-class quality:

Municipal Offices, Dale Street,
(Borough Engineer's Department),
Liverpool, January 19, 1875.

Gentlemen: In reply to your application of the 18th January instant, I beg to state that you have supplied us, through Messrs. W. Barker, Jr. & Co., within the last year, with about 413 tons of Portland cement. The various deliveries at Waterloo Road, amounting to 285 tons, have been tested, with the following results:

				Pounds.		*Pounds.*
5	Molds	breaking	strain	over 700	and under	800
23	"	"	"	800	"	900
29	"	"	"	900	"	1,000
31	"	"	"	1,000	"	1,100
9	"	"	"	1,100	"	1,200

97 tests; average breaking strain, 965 pounds.

The standard test, below which we do not accept any cement, is 700 pounds.

Since November 2d, 1874, I have required cement to be so fine that it will not leave a residue of more than 10 per cent in a 50-gauge sieve, and the requirement has been complied with. Altogether the result has been very satisfactory.

George F. Deacon,
Borough and Water Engineer.

To Messrs. Brooks, Shoobridge & Co.,
Portland Cement Manufacturers,
60 Fenchurch Street, London.

This brand of cement was used in the work of the State Prison at Providence, R. I., and is now being employed by the Sewerage Department of the city of Boston, with the utmost satisfaction. Scotch Roman cement Scotch and Welsh fire bricks, house roofing lining and ship sheathing felts of the brands named, are also well known to dealers and consumers in this and other countries. Messrs. H. L. Thomson & Co., of No. 3 Bowling Green, New York city, are the sole representatives of the manufacturers of the above-named goods in this country.

An Ingenious Device.

A window blind that can be converted into an awning has been long sought after, but it was reserved for for the E. P. Pierce Manufacturing Co., 32 Hawley street, Boston, to solve the problem with their patent improved hinges and fixtures. They now offer a unique arrangement for the immediate change of a closed and well-fastened blind into a perfect screen.

Design for a Small Cottage.

We publish this month plans and perspective view of a small cottage, from designs of Wm. H. Beers, architect, of 150 Broadway, this city. This cottage is intended for erection at the seashore, or in the suburbs, and in either locality would give a highly pleasing and picturesque effect. In the former locality it would be well suited for the wants of a family spending the summer there, while in the latter it would prove a highly desirable residence for occupancy the year round.

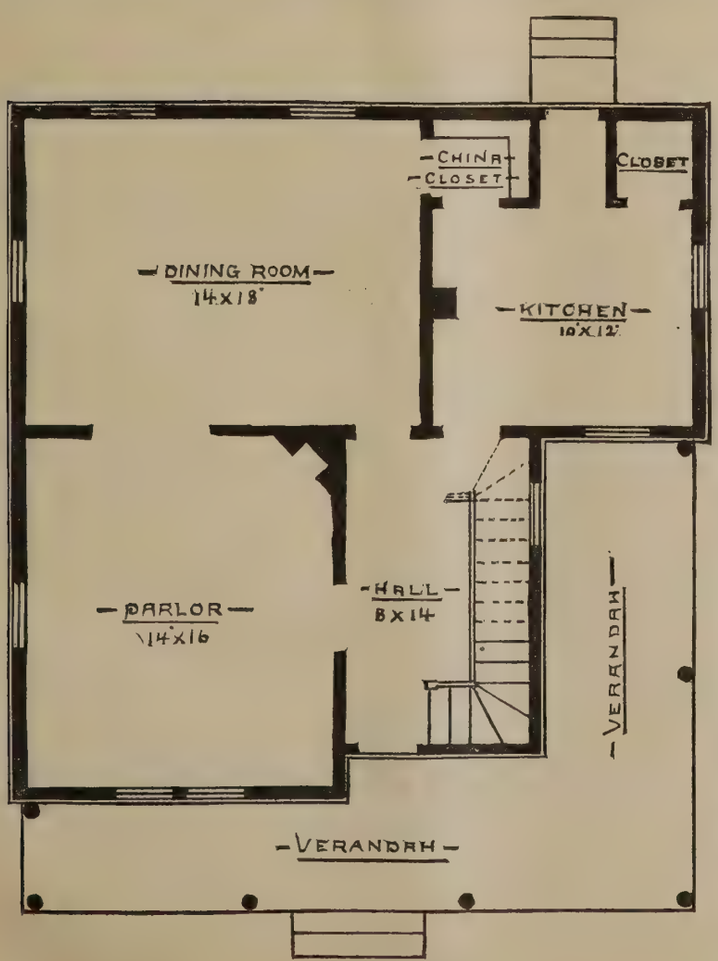
The house stands on a brick foundation, with a cellar excavated under the whole building. There are on the first floor three rooms, with hall and staircase; the parlor is in front and the dining-room in the rear, connected by folding doors; and at one side of this room, connecting by double doors through the butler's pantry, is the kitchen, fitted with closets and all the necessary fixtures to render it complete. Under the staircase in the hall there is a flight of steps leading to the cellar.

On the second floor there are three large chambers, and a small room at the end of the hall, all liberally supplied with closets; also a small sewing-room in front.

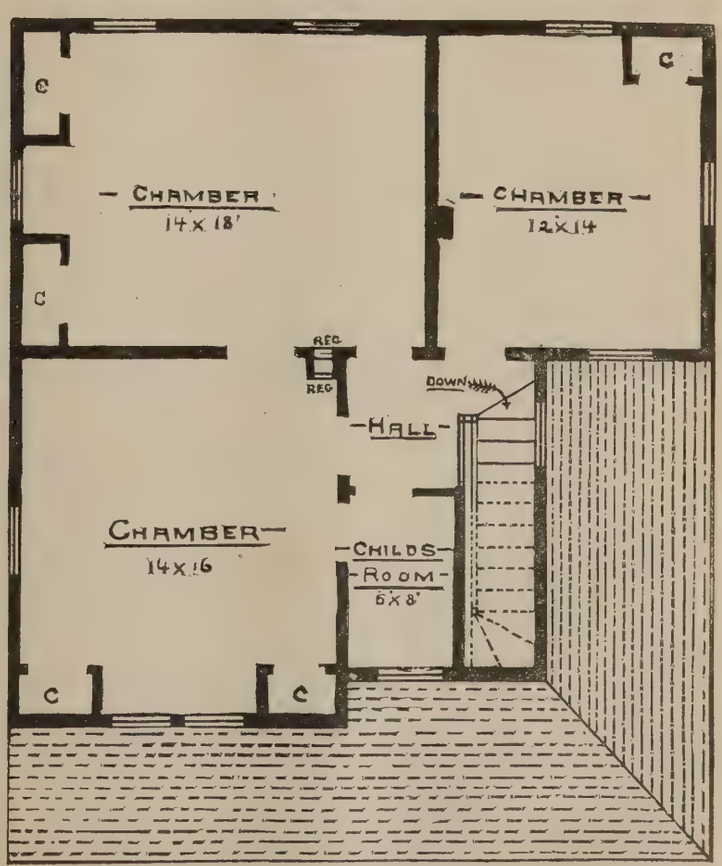
There is a piazza part way across the front and continuing around on the side. The frame on first story is covered with clapboards, and on second story to eaves, shingled.

This cottage, built in the best manner, would cost, complete, exclusive of plumbing, $1,600. Any further information in regard to it can be had of the architect.

DESIGN FOR COTTAGE, COSTING $1,600.—W. H. BEERS, Architect.



First-Floor Plan.



Second-Floor Plan.

Sanitary Construction and Arrangements of Dwellings.

BY PROF. W. H. CORFIELD, M.A., M.D.

(*Continued from Page 42 of February Number.*)

This brings us naturally to say a little about lighting. Candles, lamps and gas make the air impure. It is calculated that two sperm candles, or one good oil lamp, render the air about as impure as one man does, whereas one gas burner will consume as much oxygen and give out as much carbonic acid as five or six men, or even more. This is why it is commonly considered that gas is more injurious than lamps or candles, and so it is when the quantities of light are not compared; but with the same quantity of light, gas renders the air of a room less impure than either lamps or candles. If, in the dining-room, instead of using five or six gas burners, as we too often do, without any provision for the escape of the products of combustion, we used 40 or 50 sperm candles instead of 6 or 8, we should have a fairer comparison between gas and candles. I have no time to enter into a discussion of the relative merits of various kinds of candles and lamps, but with regard to gas I would say that, considering the fact I have just stated, it is always advisable to provide a means of escape for the products of combustion immediately over the gas burners. By this not only may these products be carried away, but with a little contrivance, heated air may be drawn out of the room at the same time, and so an efficient shaft provided, in addition to the one found already in the chimney. Very simple contrivances will answer this purpose. A pipe, with a funnel-shaped end, starting from over the gas burner, and carried straight out into the open air, with a proper inlet opening, is all that is required in some instances, as in badly placed closets. For large rooms, the sunlight ventilators are found to answer admirably. They should be provided with a glass shade, placed below them to intercept the glare, and to cut off a large portion of the heat. An elegant contrivance for dwelling rooms is Benham's ventilating globe light. In this, the products of combustion of the gas pass along a pipe placed between the ceiling and the floor of the room above, into one of the flues; this pipe, being surrounded by another opening into the ceiling of the room at one end, and into the flue at the other, is guarded at its entrance to the flue by a valve which can be easily shut when the gas is not burning. This double tube, as it passes under the floor of the room above, is covered with fire-proof material, so that the floor is not affected by it. The joists, where they are notched, have iron bearers put across to support the floor boards above. Air is admitted by another pipe passing through the wall of the house into the external air, and ending also in the ceiling of the room by openings around those of the exit shaft. Thus warm air is introduced into the room at the same time that vitiated air from the upper part of the room, and also the products of combustion of the gas, are carried out of it into the chimney flue.

I may say a few words about some grates and stoves that have been devised with a view of combining ventilation and heating. The first of these is Capt. Douglas Galton's grate, in which there is an air chamber placed around the flue, communicating on one side with the external air, and on the other with the atmosphere of the room by various apertures. The outer air which passes into this chamber is warmed by contact with the heated flue, and issues into the room, thus supplying the room with warmed air, and utilizing a considerable quantity of the heat that would otherwise be lost. There are several other grates, such as the Manchester school grate, made upon this principle, with variations in the tubes, etc. It is important in all these contrivances, where outer air passes through a chamber in which the back of the grate and flue is placed, that the back of the grate and the commencement of the flue in that chamber should be cast in one piece of metal, so as to have no joint. If there are joints, they will become, after a time, defective, and the air from the flue is liable to escape into the chamber around it and be brought back into the room by the entering air. Some slow combustion stoves, as George's "calorigen," have air pipes passing through them, and have the external air warmed on its way through the stove into the room. Slow combustion iron stoves dry the air too much, and unless they are lined with fire-clay, are apt to become too hot and to cause an unpleasant smell in the room by the charring of the organic matter in the air. They are much more suitable for warming large buildings, where economy of fuel is an important object, than they are for use in sitting-rooms or offices. It is usual to place a vessel of water on the top of these, with the view of obviating, as far as possible, the dryness of the air that they produce. It must be borne in mind that closed slow combustion stoves do not act as ventilators, as the air to supply the fuel—usually coke—is brought by a pipe from outside, and this is another reason why they are not so advantageous as an open fire or a quick combustion stove in dwelling-rooms. In the thermhydric grate of Mr. Saxon Snell a small boiler is placed behind the grate, and communicates with a series of iron pipes alongside of it; these are filled with water, which is of course kept warm, and air is admitted to the room between these hot-water pipes. Thus, it is neither dried nor heated too much. The products of combustion are carried away by a flue, which may be placed under the floor; so that the grate, if required, may stand in the middle or in any other part of the room. Gas stoves are gradually becoming largely used instead of coal stoves, and when proper provision is made for the escape of the products of combustion, they are certainly very convenient and cleanly contrivances. I have no doubt that this will in the end be found to be the proper use for gas, and that we shall cease entirely, or almost entirely, to use coal in our houses. By using coal in the way that we do, we lose all the valuable by-products—the ammonia, the tar, the carbolic acid, aniline dyes, etc.—which are derived from the refuse of gas works, and which are worse than useless to us in our fires. Gas may be burned either mixed with air or not; in the first instance a gas stove or grate filled with pumice stone or asbestos does not much resemble an ordinary fire, but if the gas be burned unmixed with air it is almost impossible to tell the difference. Generally speaking, it is found necessary, when there are several gas stoves in a house, to have a special supply of gas with larger pipes for them. What the gas companies should do is to lend gas stoves of various kinds, especially cooking stoves, to their customers for a small annual payment, as is done very successfully in continental cities. It is important that gas cooking stoves should not give an unpleasant smell of unburnt gas, as some do. This is not only a waste but a nuisance, as coal gas always contains carbonic oxide, (an extremely poisonous substance), and should therefore not be allowed to escape into the air, even in the smallest quantity.

I have now to mention an artificial system of ventilation which has been lately introduced by the Verity Brothers. It consists of a fly-wheel fitted with fans or vanes; the wheel is made to revolve by a jet of water directed against it, supplied from a cistern overhead, the water passing off by a pipe into a cistern below. The apparatus can be fixed either in an inlet opening, and so made to propel air into the apartment through an aperture in the wall placed higher than people's heads, and made in a slanting direction, so that the entering air is shot upward toward the center of the room; or it can be used as an extractor, by placing it in an exit shaft, and causing it to draw out the vitiated air. The supply of water can be regulated by taps to the greatest nicety, so that the wheel can be made to revolve at whatever speed is desirable. The entrance pipes are sometimes fitted with a vertical tube containing a box, in which ice can be placed, or a holder for perfume or any deodorant. For smoking-rooms it is found advisable to use the apparatus as an extractor only, and to allow the air to come in by means of Tobin's tubes. Dwelling houses are seldom warmed and ventilated by means of hot-water apparatus, and so I do not think it necessary to enter into a description of the plan by which this may be effected. I need only mention Pritchett's "miniature hot-water apparatus," if I may so call it, by means of which a single room may be warmed and ventilated. The water starts from a small boiler, the size of an ordinary kettle, which may be placed on a fire anywhere, or heated by a spirit lamp, and passes through a narrow space between double cylinders, the inner cylinders being used for the admission of fresh air, which is warmed in passing through them, or for the extraction of foul air. The water is made to pass through the extraction cylinders first, while it is hottest, and then through the others and back to the boiler. The cylinders are placed vertically, so that the air is admitted into the room in the proper direction. Other systems of artificial ventilation are suited for large public buildings, but are not adapted for use in dwelling houses.

New Publications.

The Sugar Beet. An Illustrated Quarterly, devoted to the Cultivation and Utilization of the Sugar Beet. Edited by Robert Grimshaw, Ph. D., and Lewis S. Ware, M. E. Subscription, including postage, 50 cents per year, payable in advance. Sample copy on receipt of three-cent stamp.

From the circular containing the announcement that this organ of a prospective industry is shortly to appear, we glean that its province will be: 1. To impress the community with the immense importance of at once establishing in our midst these useful and profitable industries, no longer an experiment abroad, and which, as the great Thiers said, "thrice saved France from ruin." 2. To assist those engaged in the culture of the sugar beet in obtaining the largest and best paying yield and the best market. 3. To discuss the processes and machinery used in the manufacture of sugar, alcohol, and other beet-root products; stock-feeding from the beet direct and its pulp, etc. The prospectus further urges that farmers and agricultural societies throughout the country should realize the importance of a journal of this character, and give it their support by subscribing to it, and by informing the editor of their success in growing the sugar beet, and the probability of the sugar beet industries being established in the sections of the United States in which they reside.

The *Sugar Beet* will be published by Henry Carey Baird & Co., 810 Walnut street, Philadelphia, in whose care letters to the editors may be addressed. We wish the new enterprise a speedy realization of its expectation of becoming "the organ of a new and important industry."

The Geological and Natural History Survey of Minnesota. The Seventh Annual Report for 1878. Minneapolis: N. H. Winchell in charge. 1879.

This volume comprises: 1. An account of the mineral interests of the northern part of the State, which proved to be neither extensive nor important, and possesses therefore only a local interest. With respect to the occurrence of silver in the great argentiferous formation, or gray quartzite (No. 4), in the northern part of the State, the report however speaks encouragingly. 2. A table of elevations of some fifty points on the Minnesota Northern Railroad. 3. A list of plants of the north shore of Lake Superior. 4. A report on the general mission of the survey. 5. Several appendices, of which one is an elaborate description, with numerous plates, of the microscopic entomostraca, by C. L. Herrick.

The report of the members of the survey who examined the mineral occurrences in the northeastern part of the State, it appears, was somewhat disappointing, since not a single important discovery was made. The geological survey of the State is expected to be practically completed in three more years, when the finished results of all the operations will appear in detail in several volumes of a final report.

Transactions of the American Institute of Mining Engineers. Vol. VII. May, 1878 to February, 1879. Easton, Pa.: Published by the Institute. 1879.

This volume comprises the proceedings and papers of the Chattanooga, Lake George and Lake Champlain, and Baltimore meetings, embracing no less than forty papers, many of them from the most prominent mining engineers and metallurgists of the country. This society is unquestionably the most active scientific body in the United States; its membership includes nearly every name of prominence connected with mining and metallurgy in the country; the periodical meetings are largely attended; and the papers presented, and the character of the discussions thereon, will bear comparison, both in quantity and quality, with those of any similar society abroad. The present volume, like its predecessors, bears the marks of Dr. Drown's careful editorial supervision, and is most creditable to the reputation of the Institute.

The Connecticut Business Directory for 1880. A Complete Index to the Mercantile, Manufacturing and Professional Interests of the State; together with much Valuable Miscellaneous Information. Boston: Briggs & Co., Publishers. 1880. Price $2.

This work is a very complete reference book to the business

and professional interests of the State of Connecticut, and will be found most useful to every one having correspondence with the business or professional men of that State, or who is in search of information of an official character relating to the banking institutions, newspapers, railroads, population, institutions of learning, State and United States officials, etc. The name of each firm or individual is arranged alphabetically by business and town, and the post-office address is also given when it differs from the name of the town.

The Builder and Wood-Worker. Under this title the publisher of the *American Builder* and the *Illustrated Wood-Worker* presents the patrons of these well-known papers with a handsome magazine in new dress, combining, as indicated in the title, the features of both. We wish the new departure a full measure of success.

OTHER PUBLICATIONS RECEIVED.

Shoe and Leather Reporter Annual for 1880. Published by the Shoe and Leather Reporter, New York.

The Trade-Mark Laws of the States of the United States. By Francis Forbes, LL.B. Prepared for the United States Trade-Mark Association. New York: The Iron Age.

Catalogue of Dartmouth College and the Associated Institutions, for the year 1879-80. Hanover, N. H.: Printed for the College.

Bulletin of the National Association of Wool Manufacturers, founded November 30, 1864. Edited by John L. Hayes, LL.D. 95 Milk street, Boston. 1879.

Geological Survey of Japan. Reports of progress for 1878 and 1879. By Benjamin Smith Lyman. Tookei: Published by the Public Works Department. 1879. Pp. 266, 8vo. From Chas. S. Heller, Philadelphia.

United States Commission of Fish and Fisheries. Commissioner's Report, 1877, comprising—A. Inquiry into the Decrease of Food-Fishes. B. The Propagation of Food-Fishes in the Waters of the United States. Washington: Government Printing Office. 1879. Pp. 982, 8vo, with numerous plates. From Prof. Spencer F. Baird.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2584) Behavior of Mixed Gases.—If I pass either oxygen or hydrogen through a compound gas composed of NO,Cl, (nitric oxide and chlorine), what will be the probable result? If hydrogen, will it unite with the chlorine? and if oxygen, will it unite with the NO? and if in excess, form nitric acid by keeping the gas over water?—A. Van der V., Belleville, Ontario, Canada.

(2585) What is a Safe Petroleum Oil?—I have heard it asserted that accidents have frequently occurred with petroleum that stood a flashing test of 100° Fah., which I understand is the legally fixed standard in this State. I am desirous of knowing if such a thing is possible.—W. M., Phoenixville, Pa.

(2586) Electrical Battery from Metals Alone.—Please tell me how I can construct quite a powerful electrical battery by using metals only.—H. D. E., Jackson, Cal.

(2587) The Strong Water Gas Process.—I find frequent allusions to the Strong water gas, as if the article were a positive success. I have not been able to find that it is in continuous use for lighting any city or town. Experiments amount to but little. If you can name any place where it is used continuously and exclusively, please do so.—B. H. B., Philadelphia.

(2588) Aluminum.—Where can I obtain some aluminum metal? Has it any importance in the arts?—J. C. T., Pittsburgh, Pa.

(2589) How Celluloid is Worked.—I read an article in your January number on celluloid, and derived much information from it, but would like to know something more about the way it is worked. You say it can be made plastic and pressed into molds; but there must be many other interesting mechanical details about it. I would thank you for any further information, if you have it, on those points.—H. R., Hartford, Conn.

(2590) Concrete for Cellar Walls.—Can you give me some information about concrete for the cellar walls of a house or barn—the proportions of the materials, sand, gravel, cobblestone, and lime or Rosendale cement? the durability, thickness, etc.? Also the difference in cost of concrete and solid stonework. Is it more liable to settle and crack, so as to tumble down, than solid stone? Would it be necessary to have the corners of square stone?—W. H. M., New Haven, Conn.

(2591) Speed of Line Shafts.—I have always taken great interest in that portion of your journal devoted to questions and answers, as you are so elaborate in your answers that one cannot mistake your meaning; not, as I have often seen in the *Scientific American*, a short "Yes" or "No," snapped out apparently in a careless, impatient way, giving no satisfaction to those seeking information. By answering this and the two following questions, you will confer a favor: At what speed ought a line shaft run in a planing mill?—L. W., Ironton, Ohio.

(2592) To Compute Horse-Power.—What is the simplest way to compute the horse-power of an engine?—L. W., Ironton, Ohio.

(2593) Capacity of a Steam Boiler.—We have a boiler 36 inches diameter, 18 feet long, with two horizontal flues of 12 inches diameter running the entire length; grate surface, 4 feet by 4 feet 6 inches; chimney, 50 feet high and 2 feet diameter. Would such a boiler be large enough to run an engine of 12×24 at 80 or 90 revolutions per minute, with 70 pounds pressure of steam, and develop full-horse-power according to above dimensions?—L. W., Iron, Ohio.

(2594) Freezing Mixtures.—Is there any cheap freezing mixture that will give me a greater cold than ice and salt? If so, I would like you to give me the recipe for it.—C. H. P., Camden, N. J.

(2595) Cooling Beer.—I wish to know what the best process is for cooling beer. At present they are cooling it with the ammonia and ice process in this city. It is something that is greatly in demand, and I thought that if you had anything new or better I would like to know of it, or of some person who uses a better process. If not, can you inform me which is the better of the above mentioned processes?—J. L. F., Cincinnati, Ohio.

(2596) Fixing and Toning.—Will you please explain what is meant by the terms "fixing" and "toning" in making photographs, and by so doing oblige.—N. McD. S., Providence, R. I.

(2597) Vulcanized Fiber.—I send you with this a scrap of a material which I am told is made from paper, somewhere in the East. It is said to be used for washers, steam joints, etc., and to be very durable for this and other uses. Do you know of it? If so, I would be obliged if you will devote a paragraph to it in your journal.—C. C., Tucson, Arizona.

(2598) Fish Rendering.—I would like to get some information about the way fish are handled to manufacture fish oil and fertilizers. I have heard of there being some great improvements in this industry lately, and that it could be made profitable anywhere along our seaboard within reach of transportation.—J. C. McH., Charleston, S. C.

(2599) Flame Engine.—What kind of an engine is a "flame engine"? Is it a different machine from what we call "gas engines"?—J. P. L., Meadville, Pa.

(2600) A Medical Question.—I have a fat and apparently healthy babe, (10 months old), and my wife likes to take it out occasionally, but is afraid to do so if the weather is below freezing point, as the babe is almost certain to have the croup, although we clothe it warmly. I would thank you for any recipe that would prevent croup.—W. I. M., South Boston, Mass.

REPLIES.

(2584) Behavior of Mixed Gases.—It is difficult to state with positiveness exactly what will transpire when mixtures of gases, such as our correspondent has named, are brought together, as the result will most probably be modified by the relative proportions of the gases present, by the temperature, and other physical surroundings that may happen to rule at the time, and which have a decided influence in modifying chemical affinities. In a general way only, we will venture the opinion that where hydrogen gas is admitted to a mixture of nitric oxide and chlorine, a union between the hydrogen and chlorine will take place, either very slowly or with more or less of explosive violence, according as the quantity of the nitric oxide present is small or in excess, or as the quantity of hydrogen admitted is in proper proportion to satisfy the affinity of the chlorine, or is much below or much in excess of the proper quantity; or according as the experiment is performed in the dark, or where the light can influence the reaction. Where oxygen is admitted to such a mixture as our correspondent names, (nitric oxide and chlorine), the oxygen will unite with the nitric oxide to form what is commonly called hyponitric acid, and this in the presence of water will be decomposed into nitric acid and nitrous acid. This reaction will occur whether oxygen is admitted in excess or not. But if we suppose that an excess has been admitted, it is most probable that in presence of water the nitrous acid formed in the operation would slowly oxidize itself, at the expense of the surplus, into nitric acid, so that all the nitric oxide would, in this manner, in time be converted into nitric acid. It is highly improbable that the chlorine would take any part in these reactions, as the oxygen compounds of this element are only formed by indirect processes, and with considerable difficulty. Our correspondent must not overlook the fact that "by keeping the gases over water," the chlorine will be speedily absorbed, and that this solution of chlorine will gradually decompose under the influence of light, the chlorine uniting with the hydrogen of the water to form hydrochloric acid, while the oxygen of the water will be set free. This reaction taking place simultaneously with the others above named, would complicate matters somewhat; but we believe that the general result of these several interactions will be about as we have stated in what has preceded.

(2585) What is a Safe Petroleum Oil?—Such a thing as an explosion with a petroleum oil that has a flashing point at or even above 100° Fah., is not only possible in ordinary use, but (though we do not positively know that any such case has ever been brought directly to our knowledge) we think it quite a probable occurrence. Prof. C. F. Chandler, of this city, made a large number of experimental tests with a great variety of lamps, to ascertain to what temperature the oil within the body of a lamp would be heated while the same was being used. These experiments, which were made with lamps of glass and metal, and of various forms and shapes, proved the highly important fact that, with many forms of lamps in common use, the temperature of the oil in them may run above the point fixed by law (100° Fah.) as the temperature of safety. For example, he found that with the air at a summer temperature of 90° to 92°, the temperature of the oil in the burning lamps ranged from 84° to 129° Fah., as the appended synopsis of his results will show:

	In 25 Lamps.	*In 13 Metal Lamps.*	*In 12 Glass Lamps.*
Highest temperature observed	129°	129°	98°
Lowest temperature observed	84°	84°	82°
Average	98.75°	104.5°	92.6°

Prof. Chandler very properly draws the inference from these experiments that the limit of safety fixed by law (100° Fah.) is too low. He says: "By these results it appears that the temperature of oil in lamps often rises much above 100° Fah., thus reaching a temperature at which oil, *which does not emit a combustible vapor below* 100° *Fah., would be dangerous.*" "It is apparent," he continues, "that 100° Fah. is *too low* a standard for safety; 120° Fah. would not be too high a standard, and its adoption would but add a few cents per gallon to the cost of the oil." This covers the question asked by our correspondent, exactly and completely.

(2586) Electrical Battery from Metals Alone.—If we understand our querist aright, we suppose he means how he can construct a simple apparatus, employing metals only, which shall give a powerful electric current, like the ordinary galvanic battery. If this is the right interpretation of his question, we would say it has not yet been done. To produce a strong electrical current by simple means, requires that two metals be put in contact with each other, either directly or by metallic wires, and immersed in an exciting liquid capable of acting chemically upon one of them—the positive element of the circuit. It is true that an electric current can be produced by taking two unlike metals—a series of alternating bars of antimony and bismuth, for example, soldering the two together at one end, connecting the other ends of the two by means of a wire or other good conductor, and applying heat to the soldered end. Currents produced by this means are called thermo-electric currents, and will continue to flow so long as there is any difference of temperature between the opposite ends of the bars. But such currents are of very feeble intensity, and this method would not serve our correspondent's purpose for a powerful battery. As the form of his question excludes the dynamo-electric machines, which would give him currents strong enough for every purpose, we are obliged to "give it up."

(2587) The Strong Water Gas Process.—The Strong water gas process has not, up to the present time, been introduced into any city or town for lighting purposes. The parties interested in the Strong patents, so far as we are informed, have devoted their whole energies to the task of demonstrating the adaptability of the process for metallurgical uses. They have succeeded, we believe, in demonstrating that it affords the cheapest method of generating water gas that has yet been devised, which has the advantage over the Siemens gas of consisting almost entirely of combustible gas, while the latter carries notable quantities of carbonic acid and nitrogen. It appears to us to be highly probable that this process (or some modification of it) is destined, sooner or later, to play an important part in furnishing the heating gases in metallurgical operations. We are advised, however, that an illuminating gas plant, employing the Strong process for water gas, which is subsequently enriched after the manner employed in the Lowe apparatus, is shortly to be erected in one of the leading towns of the East, though it would be premature to give the statement as a fact until the work has been actually started.

(2588) Aluminum.—The manufacture of this metal is confined to a few—not exceeding a half dozen—establishments, about equally divided between Paris and Berlin. We doubt if you could get any of it, except perhaps in the form of specimens for laboratory and lecture-room uses, and at high prices, from chemical dealers, without giving an order through some reliable house for the quantity you need direct to the French or German manufacturers. The aluminum industry has been a very disappointing one. When it was first produced, its very peculiar properties attracted widespread interest, and it was generally predicted that at no distant day its production and application in the arts would take rank as a great industry; and when, not many years ago, M. St. Claire Deville—a noted French chemist—showed how it could be produced on the commercial scale, the opinion was almost universal that the long-predicted revolution in many of the arts had at length arrived. It is probable, however, that one of the principal reasons for the limited demand for aluminum is its considerable price, which ranges from one-half to three-fourths that of silver, and which consequently is sufficient to bar it out from many useful applications where it might otherwise, by reason of its peculiar properties, be advantageously substituted for the cheaper metals in common use. This fact is one of the greatest obstacles to the extension of the consumption of aluminum for industrial uses, and until some cheap mode of producing it

shall be devised, that will enable it to be placed in the market to compete in price, say with tin or copper, it will most probably remain stationary. It is hardly probable that its manufacture will ever be abandoned, even though its production may not be cheapened, for the reason that some of the alloys of aluminum are possessed of valuable properties, which have already obtained for them a high consideration for certain special uses. We refer here especially to the alloys of aluminum with copper—the so-called aluminum bronzes. The most practical use to which the metal itself has thus far been applied, is its application to the manufacture of engineering instruments, where its great lightness and its resistance to oxidation, make it peculiarly valuable. The other applications of the metal have little or no special interest.

(2589) How Celluloid is Worked.—Details of the nature desired by our correspondent are exceedingly difficult to give, with anything like certainty, for the reason that the celluloid industry is kept as closely secret as possible from the outside public. We felt quite as fully as our correspondent the deficiency of the article he refers to, in respect to practical details of the methods employed for working the material, but had no information at hand that was sufficiently positive to warrant our endorsement. We will, however, give him the best information we have on this subject, on the authority of a distinguished German technologist, Prof. Boettger, who doubtless bases his facts upon the modes employed for working celluloid in his country. He affirms that celluloid can be turned, bored and planed like horn. By warming it in water (or glycerine), it becomes sufficiently plastic at a temperature of 165° Fah. to allow of its being pressed into molds. These molds are of brass; they are warmed previously to being used, and after the material has been gradually pressed into them, they are cooled off in cold water. For polishing the finished articles, a mixture of equal parts of pumice stone and emery with a non-resinous soap, is used. For cementing it, a solution is employed, consisting of 1 part of shellac dissolved in 3 to 4 parts of alcohol and 1 of spirits of camphor, or a solution of fine shavings of celluloid dissolved in strong alcohol. In cutting or sawing celluloid, it is recommended to allow cold water to fall drop by drop upon the surfaces operated upon, to avoid any considerable increase of temperature. In removing the material from the forms, it is warmed to about 100° Fah.; and should the composition be somewhat brittle, which is said to occasionally be the case, it is immersed for a short time in spirits of camphor, which, it is claimed, will correct the trouble. These facts we give on Boettger's authority, and have no doubt they are entirely reliable for German practice.

(2590) Concrete for Cellar Walls.—Concrete is doubtless a first-class material for the purpose our correspondent writes us about, but unless he is familiar with the characteristics of good cement and the manner of using it, (which, from the nature of his inquiry, we infer he is not), or unless he can command the services of an expert in this line who is thoroughly reliable, we would decidedly advise him to stick to stone, or the chances will be about even that about the time his building is fairly under roof it will be ready to tumble down, by reason of the crumbling of its foundation walls. A foundation wall of concrete, of *first-class material and workmanship*, is in many respects superior to one of stone. It will be somewhat more expensive than the rough stone-work usually employed in this class of work, and it might be better to have the corners of square stone, though not necessary. The difficulty, however, in this case is that of getting good cement for the work. Save and except certain standard brands of Portland, few of the cements of commerce can be relied upon to be of uniform quality, and to put down a cellar wall without some reliable test of the quality of the cement employed would be hazardous. As to the proportions of sand or gravel to be used, this would depend entirely upon the cement; some cements will stand three or four parts of sand, and others scarcely one. On the whole, there is so much risk attending the job our inquirer refers to, that we would sincerely advise him to stick to stone, with cemented joints, and not to undertake the work in cement—except he has at command the expert knowledge and skill demanded to guarantee a good piece of work.

(2591) Speed of Line Shafts.—The tendency at the present time is to increase rather than to diminish the speed of line shafts. Good practice is to run shafts for machine-shops at 120 revolutions per minute; for wood-working machinery, at 250; and for cotton and woolen mills, at from 300 to 400 revolutions. Hollow or pipe shafting has been made to run very satisfactorily at 600 revolutions per minute. This kind of shafting, however, is too costly to be generally introduced. These speeds are not too high for successful practice. Belts can be run safely at 500 to 600 feet per minute; but on say 6-inch pulleys, lose about two-fifths of their cohesion by centrifugal force, and are a little uncertain in driving action. Ordinary cast-iron pulleys are safe also at these speeds, if well made and not too large. A 4-foot pulley should not be run over 400 revolutions per minute, according to the experience of a good engineer; but with wooden rim, properly made, a higher speed may be run with safety. We mention speeds in connection with pulleys and belts, because these are more liable to be affected by high velocities than shafts are, the belting losing pulley contact, and the pulleys losing cohesion by reason of the contrifugal force developed by high speeds.

(2592) To Compute Horse-Power.—First find the average pressure on each square inch of the piston; multiply this by the number of square inches in the piston, and by the number of feet travelled by the piston per minute, then divide this product by 33,000. The quotient will represent the number of horse-power at which the piston is working. This rule is simple enough to apply, but the difficulty is how to find the average pressure. An indicator applied to each end of the cylinder while working, would give a card from which the average pressure may easily be obtained. Without an indicator, the average pressure may be found by the following rule: Let L=stroke of piston in inches; l=piston travel in inches to cut-off; R=ratio=$\frac{L}{l}$; H=hyperbolic log of R; P=initial pressure of steam in pounds per square inch; p=mean or average pressure in pounds per square inch. Then $p=P\frac{1+H}{R}$

But this calculation involves the factor of the initial pressure—that is, the pressure that starts the piston, and this must be ascertained by some means. A sensitive spring gauge applied to the cylinder while working might show it near enough for ordinary purposes; and the point of cut-off can be obtained by measurement while the engine is slowly turned, observing the valve's and piston's motion—having removed the steam-chest cover for this purpose—and turning the engine around by hand.

(2593) Capacity of a Steam Boiler.—The boiler you refer to may be fairly called a 22 horse-power boiler—that is, counting 8 square feet of fire and water surface for each horse-power, and omitting four-10ths of the flue surface as non-effective. In estimating this kind of horse-power, of course it is meant that you use the steam in a plain, non-condensing, slide-valve engine. The grate surface provided is equal to 36 horse-power, and the chimney equal to more, if not under a hill or surrounded by higher buildings or other objects, which would direct the air in currents downward to the top of the chimney. The engine referred to is what is usually called a 30 horse-power engine, and would work to 35 horse-power if well built. You will see by these observations that the boiler is the most deficient part of the system. It requires more heating surface.

(2594) Freezing Mixtures.—There are quite a number of such mixtures that will give a greater degree of cold than the mixture of ice and salt commonly used for the purpose. In answer to our correspondent, we give a table on the authority of Dr. Ure, exhibiting the behavior of quite a number of freezing mixtures; to wit:

Freezing Mixtures.	Thermometer Sinks. From	To	Degrees of Fall.
	Degs. Fah.		
With Ice.			
Snow or pounded ice, 2 parts; common salt, 1 (From any temperature.)	..	—5	..
Snow, 5; common salt, 2; sal ammoniac, 1 (From any temperature.)	..	—12	..
Snow, 24; common salt, 10; Sal ammoniac, 5; saltpeter, 5 (From any temperature.)	..	—18	..
Snow, 12; common salt, 5; nitrate of ammonia, 5 (From any temperature.)	..	—25	..
Snow, 3; dilute sulphuric acid, 2	32	—23	55
Snow, 8; muriatic acid, 5	32	—27	59
Snow, 7; dilute nitric acid, 4	32	—30	62
Snow, 4; chloride of calcium, 5	32	—40	72
Snow, 2; crystallized chloride of calcium, 3	32	—50	82
Snow, 3; caustic potassa, 4	32	—51	83
Without Ice.			
Sal ammoniac, 5; saltpeter, 5; water, 16	50	10	40
Nitrate of ammonia, 1; water, 1	50	4	46
Sal ammoniac, 5; saltpeter, 5; sulphate of soda, 8; water, 16	50	4	46
Nitrate of ammonia, 1; carbonate of ammonia, 1; water, 1	50	—7	57
Sulphate of soda, 3; dilute nitric acid, 2	50	—3	53
Sulphate of soda, 6; chloride of ammonia, 4; saltpeter, 2; dilute nitric acid, 4	50	—10	60
Sulphate of soda, 6; nitrate of ammonia, 5; dilute nitric acid, 4	50	—14	64
Phosphate of soda, 9; dilute nitric acid, 4	50	—12	62
Sulphate of soda, 8; muriatic acid, 5	50	0	50
Sulphate of soda, 5; dilute sulphuric acid, 4	50	3	47
Phosphate of soda, 9; nitrate of ammonia, 6; dilute nitric acid, 4	50	—21	71
With Materials Previously Cooled.			
Phosphate of soda, 5; nitrate of ammonia, 3; dilute nitric acid, 4	0	—34	34
Phosphate of soda, 3; nitrate of ammonia, 2; dilute mixed sulphuric and nitric acids, 4	—34	—50	16
Snow, 3; dilute nitric acid, 2	0	—46	46
Snow, 8; dilute sulphuric acid, 3; dilute nitric acid, 3	—10	—56	46
Snow, 1; dilute sulphuric acid, 1	—20	—60	40
Snow, 3; chloride of calcium, 4	20	—48	68
Snow, 3; chloride of calcium, 4	10	—54	64
Snow, 2; chloride of calcium, 3	—15	—68	53
Snow, 1; crystallized chloride of calcium, 2	0	—66	66
Snow, 1; crystallized chloride of calcium, 3	—40	—73	33
Snow, 8; dilute sulphuric acid, 10	—68	—91	23

(2595) Cooling Beer.—So far as we are aware, no extensive brewery relies entirely upon refrigerating machines for cooling beer, or their fermenting and store rooms. The best that has yet been done with such forms of apparatus, is to make them serve as auxiliaries to assist in cooling and to cut down the quantity of ice required to be handled, stored and replenished. For cooling the decoction (of malt and hops) previous to its delivery to the fermenting tubs, much better results and more rapid action are now obtained in our first-class breweries by using, in place of water cooled by ice, (as has been the custom heretofore), a strong brine cooled by one of the several forms of refrigerating machines. By the old process it was impossible to get the cooling water colder than about 33° Fah.; while with the new procedure it can be cooled down to 27° or 28°, and with corresponding better effect. Provision for cooling the air of storehouses and fermenting rooms by machine cooling, by means of a net-work of pipes passed about the chamber in which the refrigerating material (ammonia, sulphurous acid, chymogene, etc.) is expanded or rarified, has also been contrived, but with what economical results in practice we are at this time unable to state. We do not consider it probable, for some time to come at least, that brewers on the large scale will be able to entirely dispense with the use of ice (we mean ice of natural growth) and depend exclusively upon machinery, since a break-down in the apparatus might be very disastrous. As to which of the several ice machines in the market is the best, opinions will doubtless vary, and according to preference or special circumstances in which they are to be used, one plan or another may be better adapted. On this point we should not care to commit ourselves.

(2596) Fixing and Toning.—"Fixing" is a term applied by photographers to the operation of removing unchanged portions of their sensitive films after exposure, in order to prevent any further affection of the sensitive compound after sufficient exposure has been made. It is applied both to the negative and the positive pictures—for example: The "fixing" of a negative consists in the removal of the unaffected iodide and bromide of silver remaining in the collodion film after exposure and development of the picture. This removal is effected by immersing the plate, in the dark room, in a weak solution of cyanide of potassium, or of hypo-sulphite of soda, and gently agitating the same to and fro over the film until the solution of the unchanged silver salts is completed, which will be obvious to the eye by the clearing up of the film. The "fixing" of a positive consists in removing the unaltered chloride of silver from the surface of the photographic paper after its exposure under the negative. It is accomplished in the same way. The color of a picture that has thus been "fixed" is somewhat objectionable, on which account the "toning" process is employed, to give it a more pleasing tint or tone. This is accomplished by immersing it for a while in a bath of ter-chloride of gold, where it acquires a rich violet tint. A number of recipes for the "toning" bath are given, but that generally employed consists of a solution of 4 grains ter-chloride of gold, and from 2 to 4 ounces hypo-sulphite of soda in 8 ounces of distilled water.

(2597) Vulcanized Fiber.—The material sent by our correspondent we recognize as the product known by the trade name of "vulcanized fiber," which is, or was, largely manufactured at Wilmington, Del., by a company called the Vulcanized Fiber Company. It is used for the purposes named by our correspondent, and, so far as we know, is well adapted for the same. Our correspondent is also correctly informed as to its composition. We believe it is made from paper, parchmented by the action of chloride of zinc. The paper is most probably drawn from an endless band through a strong solution of this salt, washed, passed through rollers (whereby any degree of thickness can be secured by piling sheets together) and after the sheets are dry, cut into required shapes. We have seen substantially the same material made into knife, fork, and saw handles, and many other useful and fancy articles for which hard rubber is used. The nature of the change produced in the paper by this treatment is not entirely understood. The same effect will be produced by the use of strong sulphuric acid and ammoniacal sulphate of copper. These substances, like the chloride of zinc, are solvents of cellulose—or vegetable fiber—of which paper of course is composed. It is probable that the action of these materials on paper that is only dipped into them momentarily, or rapidly passed through them, is to gelatinize the superficial layers of the cellulose, a condition which gives it much greater strength than it had previously possessed. If these substances are allowed to act on paper for any length of time, it will be completely disintegrated, and will finally disappear entirely. Parchment paper, which is quite a good substitute for the real parchment, is made by a very similar process to that above described, the difference being that strong sulphuric acid is generally used in the conversion, though the chloride of zinc will do quite as well.

(2598) Fish Rendering.—Our inquirer will find his question answered very fully, and in every respect, most satisfactorily in the lately published report of Prof. Spencer F. Baird, United States Commissioner of Fish and Fisheries. The question is altogether too general, and the subject too immense, to be properly answered here. Inquire at one of your city libraries for the volume, or address a polite letter to Prof. Spencer F. Baird, United States ommissioner of Fish and Fisheries, Washington, D. C., who will possibly be able to obtain a copy of the work in question for you. Its title in full is, "United States Commission of Fish and Fisheries. Part V. Report of the Commissioner for 1877. Washington: Government Printing Office. 1879."

(2599) Flame Engine.—It is the same as a gas engine. Knight, in his "Mechanical Dictionary," states briefly that the term "flame engine" "is an early name for the gas engine, in which the piston is moved by the expansion due to the sudden combustion of a body of gas in the cylinder." The term seems now to be rarely used, and may be considered as practically obsolete in mechanics.

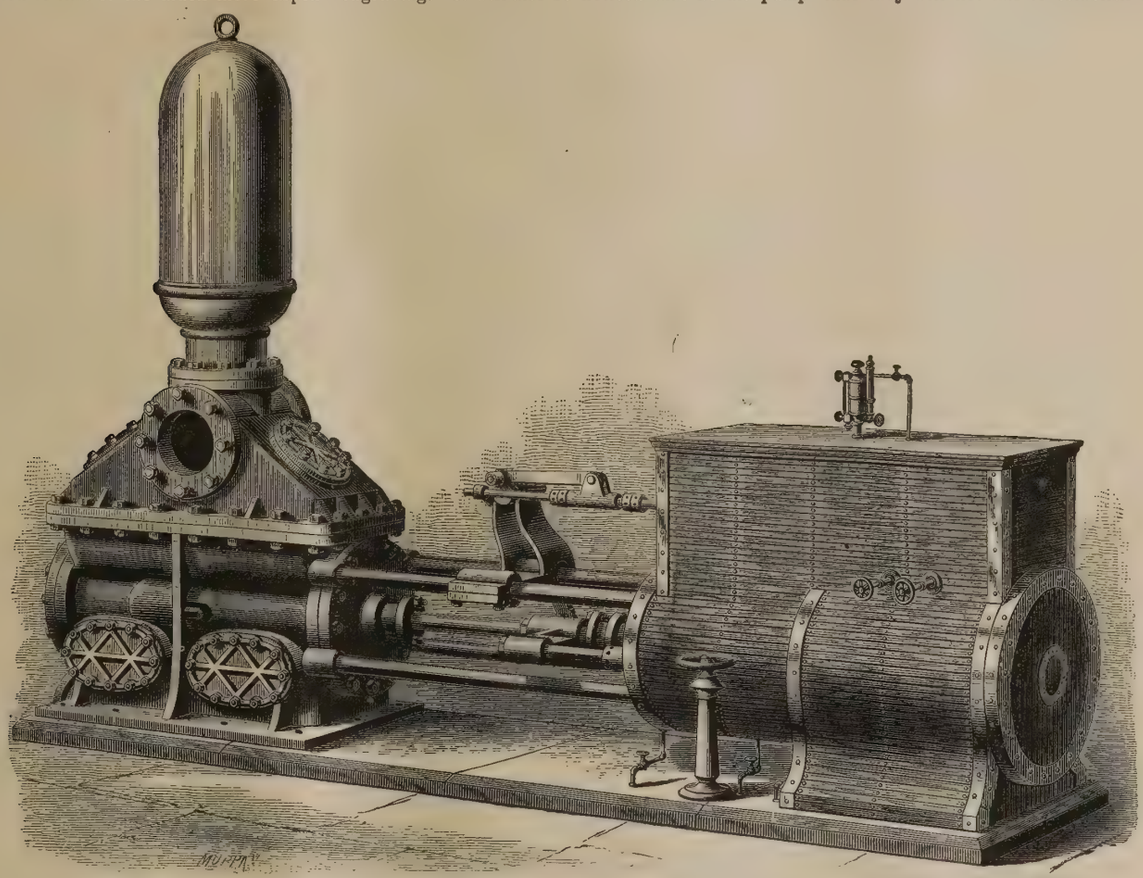
(2600) A Medical Question.—In this case the family physician would be by all means the person best qualified to give the counsel our correspondent asks. We would be most happy to aid him, but there is a manifest impropriety in giving medical advice *in absentia* through the columns of a technical journal.

THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 4. APRIL, 1880. TWELFTH YEAR.

Blake's Improved Compound Pumping Engine.

The pumping engine shown in the accompanying engraving, and which will be recognized by many of our mechanical readers, has acquired a high reputation at home and abroad as a simple, inexpensive and effective water-works pumping engine. It is direct-acting, and so devised as to secure the advantages to be derived from the expansion and condensation of the steam used. In point of economy in fuel, and in general running expense, the makers of this engine claim for it a close approximation to that of the much more expensive and complex rotative and Cornish pumping engines in general use in large cities. For town use, where such large outlays as will be demanded for the last named, cannot be afforded, this improved compound engine would seem to be specially well adapted, by reason of its many advantages, chief among which are moderate cost, simplicity of parts, general economy of operation, and comparative high duty.



IMPROVED COMPOUND PUMPING ENGINE.

The engraving shows an improved direct-acting compound pumping engine made by the George F. Blake Manufacturing Co., of New York and Boston, of the following dimensions: High-pressure steam cylinder, 18 inches diameter; low-pressure cylinder, 36 inches diameter; water cylinder, 20 inches diameter; stroke, 36 inches; capacity at average speed, 2,000,000 gallons of water per diem.

An arrangement, peculiar to this engine, controls the pumping operation so perfectly, that the annoyance and injury caused by jar and concussion (so common in direct-acting pumps) is entirely obviated. The water cylinder is built so that the suction valves are below and the delivery valves above the pump barrel. The feature of direct and roomy passages for the water to flow through, together with large area of valve openings, reduces water friction to a minimum.

The compactness and simplicity of all the parts of this pumping engine are salient points, and will no doubt strike the reader with favor in glancing at the engraving. It will also be noticed that no air pump is shown connected to the engine. This feature, or, rather the absence of the usual arrangement of connected air pumps, is certainly an advantage, as by the use of an independent condensing apparatus, the engine is relieved of a certain amount of drag—which means a saving of power.

Water-works boards and engineers fully appreciate the importance of having a compact yet well-designed engine. In the Blake compound pumping engines no costly engine houses or massive foundations are necessary, while the economical advantages resulting from the expansion and condensation of steam are very effectively obtained without the complication of parts, such as cranks, fly-wheels, working-beams, journals, connecting-rods, etc., of the rotative or Cornish pumps. The steam valves are absolutely positive—that is to say, the operation at any speed, under any pressure, is perfectly continuous, and the engine is never liable to stop on the center.

The London *Engineering*, in giving a critical report on the Blake pumping engine, says: "The result of this ingenious combination of steam valves is a perfect continuous action without any dead point, and which is attained without any complex internal arrangement. Of the excellent working of the Blake pumps at extreme ranges of speed and pressures, we are enabled to speak from personal observation, affording ample foundation for the opinion we have before expressed, that they will not fail to establish for themselves as high a reputation in England as they have in America."

Creosoting Timber for Bridges.—Mr. Edward R. Andrews, proprietor of the Hayford Patent Creosote Wood-Preserving Works at Elizabethport, N. J., has obtained the contract for the under flooring of the Brooklyn bridge, a piece of work which will require about 1,100,000 feet of yellow pine. Under the Hayford process green lumber is first steam heated, and its moisture converted into vapor, which is drawn off, leaving the wood fiber free from all substances that can ferment, and then creosote oil is pumped into the cylinder in which the wood is treated, and a pressure of 100 pounds to the square inch is applied until the wood has absorbed the requisite quantity. Wood prepared in this manner is impervious to air and water and defies

the attacks of the torpedo and other worms, and is therefore peculiarly suited for use in places where wood is employed in marine constructions or where it is much exposed to weather or traffic.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XII. No. 4. TWELFTH YEAR.

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Agencies where the Manufacturer and Builder can be Found on Sale.

The following News Companies in the principal cities of the United States and Canada are agents for the sale of the MANUFACTURER AND BUILDER, and are prepared to supply the same promptly:

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Toronto News Co., Clifton, Ontario, Canada.

The Canal and the Government.

The question of the construction of an interoceanic ship canal across the American isthmus has been agitated and discussed in all its phases by successive administrations in power at Washington. The desirability and importance of the work in the interests of American commerce, have long been recognized; expeditions for the exploration and survey of rival routes have been sent out at public expense; treaties have been negotiated with the Central American government securing to the United States ample concessions for the undertaking of the enterprise; but in spite of all the reasons why the canal across the American isthmus should have been constructed long ago by Americans as a work of supreme importance to American commerce, we have let the golden opportunity slip through our fingers, and have been brought face to face with the probability that the work we should have long ago performed as a right and duty, will be done by foreign engineers, with foreign capital and under foreign protection.

It is surprising, in view of the procrastinating spirit in which this question of paramount importance has always been considered by this government, that even this probability should have called forth an expression of feeble protest; but it may be some little satisfaction to know that the acting Executive has deemed it necessary to issue a pronunciamento defining the policy of this country from the standpoint of the traditional Monroe doctrine. What influence this announcement may have in affecting the project which the enterprising Lesseps has set himself to execute, remains to be seen. But the attitude in which the President's message places the country, reminds us forcibly of the doleful ditty of the policeman in the "Pirates . . . . ."

> "When constabulary duty he's performing,
> The policeman's lot is not a happy one."

With the opportunity, the means, and the strongest inducement of self-interest to build the canal, our government failed to do so; and now that the foreigner sets himself manfully to work to do what we should have been proud to have done years ago, we are forced to act the dog in the manger, and say to him substantially: "The policy of this country is a canal under American control. We won't build the canal ourselves, and we don't propose to let any one else build it if we can help it. You may build it if you can, but we propose to control it when you do."

The outcome of the President's message on the canal question, should Lesseps really go ahead and complete the work about which he has gone with so much earnestness, will be highly problematical. Will our government venture upon the responsibility of announcing a "protectorate" over a foreign enterprise, executed with foreign capital? Will foreign governments quietly acquiesce in this performance? If not, as appears to us to be highly probable, are we prepared to back up "the policy of this country" with authority? Whichever of these alternatives may be forced upon us, the lot of the government "is not a happy one."

There is but one right way, it appears to us, to realize "the policy of this country" of a "canal under American control," and that is to build it ourselves. But perhaps even this opportunity has passed out of our control.

Statistics of Silk Production.

Dr. Samuel Chamberlaine makes an earnest appeal for the introduction of the culture of silk in this country, in the February *Journal of the Franklin Institute.* In the course of this article he presents the following statistical facts of interest, showing in detail the product of all the silk-producing countries of the world, and the estimated value of the same:

COUNTRY.	Average Value.	1870. Estimated Product, in lbs.	1870. Total Value.	1876. Estimated Product, in lbs.	1876. Total Value.
Chinese Empire	$4	20,400,000	$81,600,000	28,232,000	$92,928,000
Italy and Pontifical States	8	5,065,000	40,500,000	7,406,000	59,250,000
India	3	8,000,000	24,000,000	11,783,000	35,200,000
France	8	3,125,000	25,000,000	3,903,000	31,246,800
Japan and Corea	4	4,525,000	18,100,000	4,950,000	19,800,000
Syria and Asia Minor	6	1,166,000	7,000,000	1,416,000	8,500,000
Turkey in Europe	6	1,166,000	7,000,000	1,320,000	7,920,000
Persia, Turkistan, etc.	6	1,066,000	6,400,000	1,041,000	6,250,000
Austro-Hungary	8	156,000	1,280,000	386,000	3,087,000
Spain and Portugal	7	457,000	3,200,000	269,000	1,884,000
Greece	6	140,000	840,000	181,000	1,087,000
Morocco	6	50,000	300,000	50,000	300,000
America (probably Mexico, Brazil, and California)	6	13,000	80,000	16,000	100,000
		45,333,000	$215,300,000	55,903,000	$267,553,400

The author then presents some statistical facts showing the extent and importance of the silk manufacture in this country. He shows from the reports of the Bureau of Statistics that the importation of raw silk from other countries to supply the wants of our manufactories reached 1,590,633 lbs. in 1878, having a value of $6,807,725; and by a comparison of the figures of this importation for a series of years back, he shows that the quantity of raw silk we import about doubles itself every five years. He concludes his plea for domestic silk culture with the following forcible remarks:

"It may be gathered from these statistics that there is in the United States an established, settled business of silk manufacturing; that it employs at least 200 firms and some 20,000 operatives, who consume more than 1,000,000 pounds of raw silk, for which over $5,000,000 have been annually sent out of the United States; and that the annual export of gold for this raw material will soon reach $10,000,000, and probably in the near future $20,000,000. All this may be readily produced in our own country, and a large part of it in the State of Pennsylvania, which, in 1844, produced some of the best silk then used by Mr. John Ryles' "Murray Mills," in Paterson, N. J. It needs but a discreet following of the example set us by the English society to encourage in every practicable way the raising and reeling of silk as a 'cottage culture and country production.' . . . A central association would be able to institute, and then foster and encourage the industry in all parts of the country. It would distribute trees, eggs, and apparatus to every favorable locality; it would gather up the cocoons for reeling, and the reeled silk itself, from all parts of the country; it would be able to sort and sell at wholesale to the consumers the quantities and qualities suitable for their business; it would so regulate the entire business as to prevent the recurrence of mad speculation, by which alone the prospects of establishing the rich industry were dashed in 1840; it would enable us to see fulfilled the

first part of M. d'Homergue's predictions,* as we already see by the tables that the second part has been fulfilled. The United States have become a rich silk manufacturing country; it remains for us to make her a rich silk growing country.

Rivals to the St. Gothard Tunnel.

The approaching completion of the tunnel through the St. Gothard, which we reviewed in our last, has called into fresh prominence several projects that have been mooted from time to time since the inception of that gigantic work, to offset for the benefit of France the commercial advantages which the latter will give to Germany, by diverting through its more direct channel the bulk of the traffic which has thus far been monopolized by the Mont Cenis tunnel.

The most promising of these enterprises is the projected tunneling of the Simplon. This would, it is claimed by its advocates, who have lately been strongly urging the French government to subsidize the undertaking, largely neutralize the advantages that would otherwise be permanently enjoyed by the commercial and political rivals of France.

The tunneling of the Simplon, if ever completed, will be a still greater work than that of the St. Gothard. It will be over 12 miles in length, as compared with the 9⅛ miles of the St. Gothard and the 7½ of the Mont Cenis. Careful surveys of the Simplon route have just been made in the interest of this enterprise, and the physical surroundings are affirmed to be more favorable than those of the St. Gothard. As all these enterprises add materially to the facilities of intercommunication enjoyed by Italy, it is not to be wondered at that that government looks upon this new undertaking with a favorable eye, and has already expressed its readiness to make most liberal concessions to its projectors.

Another rival project contemplates the tunneling of the famous Mont Blanc—an alternative project to the Simplon route, and one for which its advocates claim decided advantages over the latter. The new project is pronounced to be entirely feasible by French engineers who have proposed it, and is said to be receiving favorable consideration. Contrary to general opinion on the subject, the tunneling of Mont Blanc is declared to be an easier undertaking than that of the Simplon; the estimates of cost for executing the work being, in the case of the Simplon, 136,000,000 francs, and in the case of Mont Blanc only 75,000,000. Furthermore, it is claimed that the Mont Blanc tunnel will make the journey from Paris to Genoa 97 kilometers shorter, and from Paris to Milan 44 kilometers shorter than by the proposed Simplon route. The location of the tunnel, which meets with favor from its advocates, is said to be from Chamounix to Cormayeur. Our authority does not go into further details, but the project has met with some remonstrance on sentimental grounds.

Progress of the Pottery Industries.

The pottery industry in this country is making very rapid and substantial progress. There are now about 800 potteries in the United States, employing several thousand operatives, and representing a vested capital of $6,000,000. During the year 1879, some 30 kilns were added to the number already in operation, representing an addition of $1,000,000 to the value of products turned out.

The progress made in the direction of improving the quality and finish of the products is well shown by a *resumé* of the past and present condition of the Trenton (N. J.) potteries. That city has now 23 establishments, five of which were built and put in operation during the past year. They employ about 3,500 hands, and run 99 kilns. With respect to decorative work, the following statements, gleaned from a well-informed correspondent of the Philadelphia *Ledger*, will give an excellent idea of the attention now being given to the improvement of the artistic quality of the Trenton ceramic products:

"Only twelve years ago, the only decorator of pottery in Trenton was a German, who did the work at his home, the articles from each establishment being sent to him. The decorations at that time consisted of colored bands and gold lines, and this for toilet sets only. Since that time there has been an annual increase in the number of decorators, until now there are 300. Each pottery now has its own decorating department connected with the establishment, and the most elaborate designs are executed. Two years ago special attention was given to printing designs for pottery from copper plates. The object to be placed on the ware was first engraved upon copper plates, and the paper printed from them being in metallic colors, was transferred to the finished ware. The articles thus prepared were placed in the fire, when the colors from the paper were transferred to the surface of the ware. There are now three establishments in the city that have adopted the lithographic process in transferring the colors to the paper, which are again to be transferred to the ware. This process, it is claimed, gives an opportunity to the decorator to use more freedom for the exercise of his fancy and taste in preparing the design, as well as reducing the cost—an important consideration with the potteries, as they are endeavoring to prevent the importation of foreign ware. Great attention is also paid to getting up original designs, and these are placed upon the cheapest as well as the most expensive wares. The pottery made is of various kinds, from door knobs to vases worth from $100 to $500. It is stated that many of the American designs are now being copied by foreign manufacturers, as being more tasty and more popular than their own. So far as the market in this country is concerned, each manufacturer seems determined to succeed in this branch of the business, and the quality and beauty of their productions are rapidly taking rank with the best products of foreign lands. The demand for decorated wares is constantly increasing, and during the past year the advance made in meeting the wants of the public has been greater than any previous year. Upon this subject the United States Potters' Association, in their report, say that 'our industrial expositions, our art museums, and our schools of design have done, and are doing, much to educate all to a higher appreciation of the beautiful in art. Catering to the increased demand for home decorations, artistic and original designs in pottery have been produced, and artistic form and beauty so in-wrought in our table service as to render it not the least attractive of our household decorations. We need in this country more art schools. The success of our industrial and commercial interests depend largely upon this. A cultivation of taste and a love of art would create a demand for wares of a higher artistic order, and thus build up an industry which might in time rival the most beautiful productions of Europe. This holds good not only in the ceramic, but in every department of industrial art. It is gratifying to know that schools of design are being established by some of our members for the technical education of their workmen—a step in the right direction. Beauty combined with utility gives a commercial value not otherwise obtained.'"

With reference to the mining and preparation of the clays, and other crude materials used by the potters of this country, there seems to be much room for improvement, to make the grades uniform and reliable. The report of a committee of the Potters' Association called special attention to this pressing requirement of the trade, and presented in strong colors the lamentable deficiencies of the present rough and primitive modes of mining and grading potter's clays. Some concerted action on the part of the potters themselves, would seem to be demanded in order to bring about the radical improvement in this direction that is demanded.

These points are also brought out by the correspondent we have quoted, as will appear from the following:

"In preparing the clay and other materials, some changes have been made. Originally the crude material was mixed with water, and, after a certain time, heat was applied to evaporate the water, thus leaving the clay in a plastic form. Now pressure is used to get rid of the water, and this process, it is claimed, is more economical, and leaves the clay cleaner and in better condition to work. In reference to the raw material, it is said that it is as good in this country as in any other portion of the globe. This material is gathered from Pennsylvania, Delaware, New York, and, in fact, almost every State in the Union possesses it; but it is stated that the methods of testing and using the clays are still crude, as well as in relation to spars and silex. The chairman of the Committee on Raw Material, appointed by the Potters' Association, recently reported that he had visited three clay mines in Chester and Delaware counties, in Pennsylvania, and four in Delaware, and states that 'if the clay beds of that region are properly opened and worked scientifically, there will be found clay enough to last all the potteries in this country for a century; but the mines that have been thus far opened and worked, are without system, and the worst feature of all is that what clay they do get out is absolutely spoiled for the finest wares by a slovenly and wasteful process of mining.'"

Mr. J. Hart Brewer, President of the Association, and largely interested in the manufacture of ware in Trenton, in his address at the last meeting, said that "our advantages for manufacturing in the United States have induced foreign manufacturers and importers of foreign goods to transplant their knowledge, energy and capital to our shores. In such a commercial trade fight all the citizens of the country must join with us in congratulations over such a victory, making good, as it does, the protective theory. There is no reason why this pottery industry should not grow in the next decade, so that instead of producing annually $4,000,000 of white ware alone, we will produce the other $4,000,000 now imported from abroad."

Models not Required to Complete an Application for a Patent.

The following rules (which took effect the 1st of March) will do away with models in a large proportion of the cases filed in the Patent Office, a measure which has been advocated for many years by some of our leading inventors and patent solicitors, who have urged, and we believe very properly, that the preparation of a model in the great majority of applications for patents, was a burdensome and needless tax upon the inventive class of the country:

"A complete application for a patent comprises the petition, specification, oath and drawing, and the model or specimens, *when required.*

"A model will not be required or admitted as part of the application, until on examination of the case in its regular order the Primary Examiner shall find it to be necessary or useful, and shall file a written certificate to that effect, which will constitute an official action in the case.

"From the decision of the Primary Examiner overruling a motion to dispense with a model, an appeal may be taken to the Commissioner in person."

The dispensing with models generally will require greater care and exactness in the preparation of drawings, and of the specifications of patents, and will, if we are not mistaken, by demanding greater professional skill in the work of preparing patent papers for the office, exert indirectly a beneficial influence in raising the standard of proficiency in the profession of patent solicitor, which is greatly required. We believe that the gentlemen and firms enjoying the largest share of clientage are advocates of these modifications of the Patent Office rules.

Technical Education in the Far West.—We glean from one of the Salt Lake City dailies, the fact that a school of mechanical engineering and kindred subjects has been successfully inaugurated in connection with

* M. d'Homergue, an authority on silk culture, predicted (1830-1840) "that the United States are destined to become a great silk growing and silk manufacturing country; that the fulfillment of this high destiny may be retarded, but nothing can prevent its taking place at some future time." [*Vide* "Letters to M. Duponceau," page 63.]

the Desert University, under the immediate direction of Dr. J. R. Park and Prof. Wm. J. Silver.

Franklin Draught Regulator.

In earlier issues of this journal we have discussed the general principles which render obvious the advantages to be derived from the adoption of mechanical devices in connection with steam generators that shall automatically regulate the air supply, and, as a consequence, the steam generation, in accordance with the requirements of each particular case These principles are not so widely understood by steam users but that they are constantly violated by a large percentage of them, and an additional reference to the subject will not, under the circumstances, be out of place as a preface to an account of a new device of this kind which will be found below.

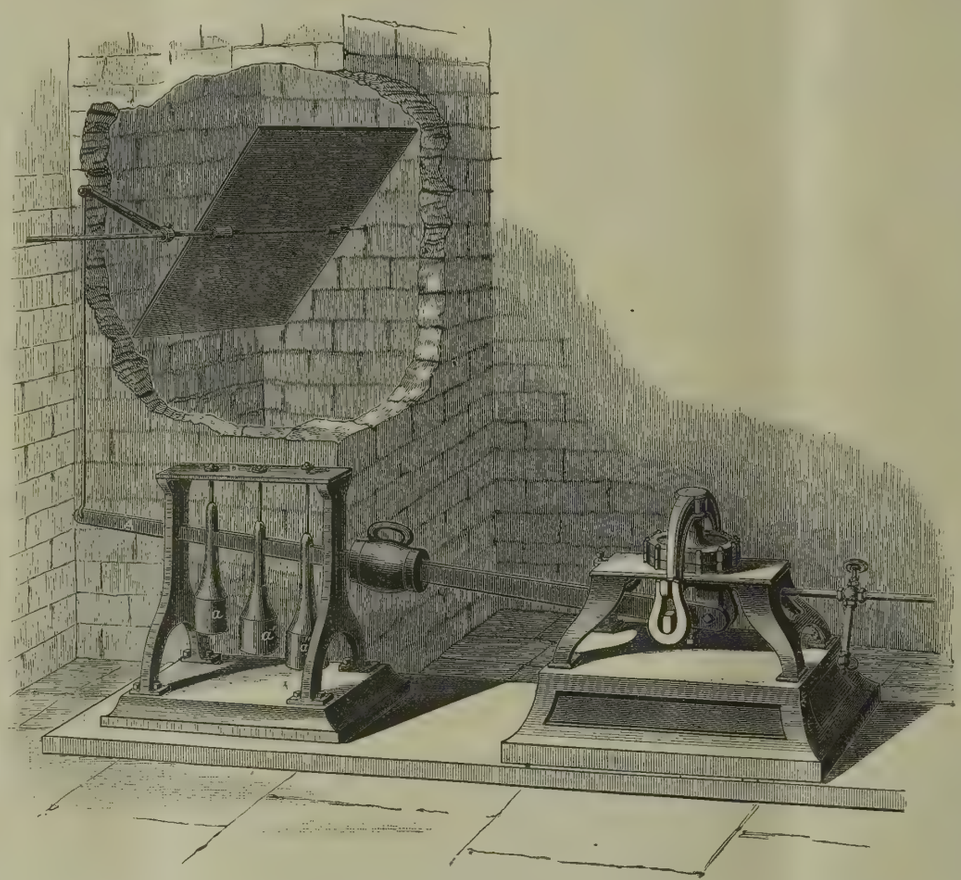
To consume fuel to the best advantage in the steam boiler, or, what is the same thing differently expressed, to use the steam boiler most economically, it is necessary to insure, first, that the boiler setting shall be such as to permit of the entrance of air into the furnace at such places and in such manner and quantity, as to insure an approximately perfect combustion; and, second, that the amount of air admitted shall be proportioned to the amount of steam required.

This second point, which has nothing to do with the setting of the boiler, can only be accomplished by placing upon the boiler, just as we do upon the engine, a governor, to limit the furnace, which shall supply it with air in direct proportion to the amount of steam used and needed; and just as the control of steam admission requires to be automatic, and could not with safety and economy be entrusted to or effected by hand, so it is none the less desirable, and even essential, having economy in view, that the steam generation be automatically regulated in precise accordance with the demand. To the neglect of this important consideration in practice, a notable percentage of the loss of effectiveness of fuel may be ascribed; it would be hazardous to say just how much is lost, but the amount will depend entirely upon the attentiveness of the fireman. But there are none who are familiar with the use of steam, who are not aware that in the vastly greater number of cases the governor of the engine is burdened with the responsibility of atoning for the irregularities of boiler regulation. For the wastefulness, and other evils of such irregularity, with which intelligent steam users are familiar, an effective automatic draught regulator is the only remedy.

We illustrate herewith a device of this kind, which is in common use for operating a damper in the chimney of a steam boiler, by means of steam pressure. The device is substantially the same as that patented by Patrick Clark in 1854, but it is combined with a lately patented improvement known as the Franklin regulator, which is affirmed to add materially to its sensitiveness. The details of this improvement are herewith given: Above the weighted lever A, is erected the plate B, supported from the framing as shown in the cut. From this plate B is suspended, from rods, any desired number of weights. In the engraving are shown three of these *a a' a''*, the rods supporting which are forked, so as to straddle the lever A, and capable of being adjusted by thumb-screws (shown above the plate B) so that the weights attached to them will be raised, not simultaneously, but one after the other, by the lever when it rises under the pressure of the steam. The lever then, by this arrangement, receives the load of one weight, and after overcoming this and rising further, receives the additional load of the second weight, and on rising still further, receives the load of the third. By the action of this mechanism, when there is a slight excess of steam pressure, the lever is raised just far enough to partially shut off the damper, as the lever will in such case be arrested in its rise by the load of the first weight, which will be sufficient to limit the draught. The gradual weighting of the lever, it will be observed, thus provides a sensitive and graded species of regulation, which is exercised as circumstances require. When the pressure returns again to the normal amount, the lever falls, the weight is left suspended from the plate B, clear of the lever, and the damper is left wide open. Should there be, however, such an excess of steam pressure as to raise the lever, already loaded by the first weight, high enough to meet and overcome the weight of the second, the damper will be still further contracted; and if the lever still rises and takes on the load of the third weight, a still further shifting off of the damper results, until it is completely closed. The action of the device, therefore, is not a sudden but a gradual one, as the circumstances may indicate; and the objection which has been made to other devices of this class, that there were but two possible positions of the damper with them—either altogether shut off, or wide open—is done away with, for, except in extreme cases, as we have above explained, the damper is never altogether open or altogether closed, but is maintained by the graded load of the weighted lever in the particular position demanded to give a draught corresponding to the normal pressure.

The regulator here described is applicable to boilers either with natural or forced draught, and the makers assert that the apparatus possesses every advantage that is to be gained by the use of a damper regulator, with none of their defects.

For further details and information, our readers are referred to Turl's Iron Works, agents, foot of West 28th street, this city.



DRAUGHT REGULATOR.

Paints.

Those who have had experience with many of the paints sold in the market, have been taught by that experience that cheap paint does not pay, lacking as it must those characteristics which a good article should possess in order to give satisfaction. Especially is this so at present when the cost of all materials entering into the composition of paint has greatly advanced. Many mixtures sold under the name of "paint" are simply washes, and it is scarcely necessary to state that these counterfeits of the true article have been very successfully palmed off to those looking to cheapness rather than to the quality of the material they were buying. This dear-bought experience, however, has been sufficient in the majority of instances to deter these would-be economists from falling a second time into their error, they having become thoroughly convinced from the knowledge gained that the old saying, "The best is the cheapest," is as true when applied to paint as to any other article of merchandise. It is not difficult to discover how the manufacturers of cheap paint are able to undersell honest dealers. Every kind of adulteration is resorted to; inferior oils, such as rosin and cotton-seed oils, gums held in solution with benzine, and other so-called "combination oils," are employed, as well as the not unusual dilution by the addition of from one-half to two-thirds of alkaline water. Such being the fact, it is not strange that the manufacturers of these washes are enabled to "cut under." The surprising part of the matter is that they charge so much in view of the inferior article they furnish; it is evident that their profits, even at their prices, must be something enormous.

In 1879, the average prices to dealers for materials used in making paint were as follows: Linseed oil, 62 cents; white lead, 7 cents; zinc, 5 cents; spirits of turpentine, 26 cents. Prices now are: Oil, 85 cents; lead, 9 cents; zinc, 7½ cents; turpentine, 48 cents, and coloring pigments, dryers, etc., have advanced in similar proportion (with an upward tendency), making an average advance of nearly 40 per cent on all materials used in good oil paints.

Now, as paints made only of good materials must cost about 40 per cent more than last year—labor, coal, packages, etc., having also advanced, it is evident that manufacturers must make an approximate advance in their prices, or by not doing so, practically acknowledge either that they do business without profit, or that they use inferior materials this year, or that they must have always used inferior materials and charged higher prices than their goods were worth; and if a manufacturer advances his prices only 5 or 10 per cent, inferences can easily be drawn, for there has yet been

discovered no way to put one dollar's worth of materials together at a cost of seventy-five cents.

It is refreshing to find in the trade, manufacturers who are using their efforts to expose the "cheap men," and are counteracting their false pretensions by furnishing a first-class article at a fair price; notably among these are the H. W. Johns Manufacturing Co., of 87 Maiden Lane, New York, whose excellent asbestos liquid paints have been frequently commended by us for their beauty and durability. Although these paints are of course higher in price than those referred to in the beginning of this article, they are infinitely cheaper in the end, as has already been made obvious. The manufacturers of these paints state that, notwithstanding the rise in prices noted, they will make no change in the quality, and, as heretofore, shall make but one grade of paints—that is, the best which can be produced from the best and purest materials; but owing to the immense increase in the demand for their paints, and increased manufacturing facilities, they purpose for the present giving their customers the advantage of favorable contracts they have made for a portion of their raw materials, and make an advance of less than 25 per cent on their average prices of last year. They also call attention to the fact that the average weight of their shade paints is 15½ pounds, exclusive of packages, or 16½ pounds in gallon cans. Their *outside* and *inside whites* weigh respectively 2 and 2¼ pounds more than their shades, and if reduced with linseed oil to the same weight, would cost no more; in other words, the cost per pound is about the same, the additional weight being necessary in consequence of the natural transparency of the purest white, which they use exclusively in connection with clarified Calcutta linseed oil, producing a full bodied liquid white, two coats of which they claim will be found equal to three of any other in covering properties, and superior in brilliancy and durability to the best white lead. They claim theirs to be the most perfect paints ever made for structural purposes, and that they command their price for the reason that they are not only better and worth the difference, but are in fact more economical for the consumer.

For twenty-two years the above company have made a specialty of manufacturing preservative paints and coatings for wood, metals, fabrics, etc. Six years since the manufacture of liquid paints for general structural purposes was commenced by them on an extensive scale, Some of the finest public and private buildings and most extensive structures in the country are decorated with these paints, among others the United States Capitol at Washington, the Metropolitan Elevated Railroad of New York, etc., as well as thousands of the better classes of dwellings.

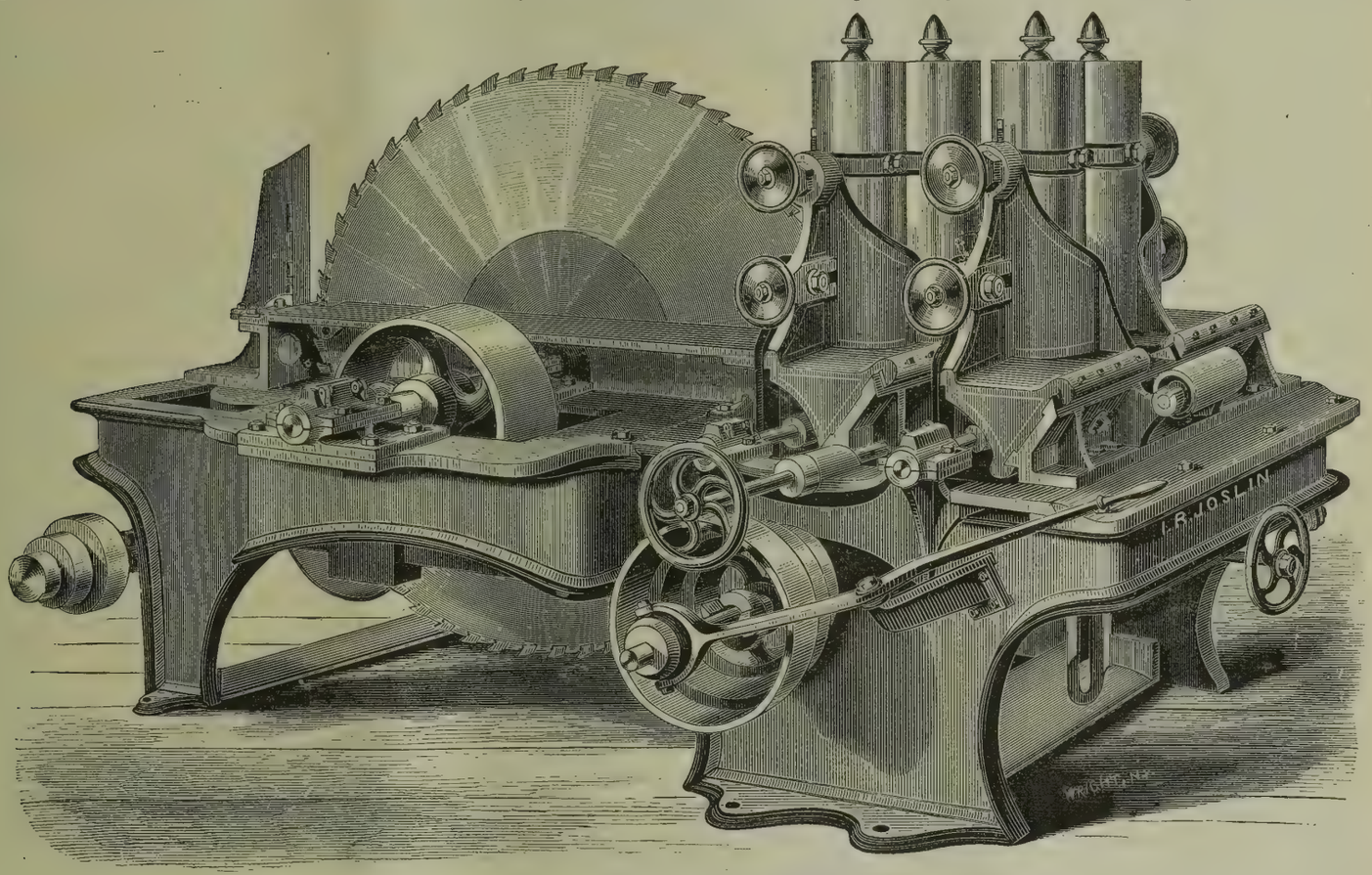
The manufacturers have again recently doubled the capacity of their paint works, and claim their facilities for manufacturing are not equaled by those of any other paint manufacturer in this country.

Improved Re-Sawing Machine.

We illustrate and describe herewith the improved machine known as "Joslin's Re-Sawing Machine," manufactured by the S. A. Woods Machine Company. The engraving represents a large and powerful circular re-sawing machine, with iron frame and 50-inch saw. It works lumber 22 inches wide and 3 inches thick, and can be made to slab from the side of stuff 4 or 5 inches in thickness. The feed is continuous, with three changes, the quickest being 85 feet per minute, and can be stopped and started without stopping the saw. The feed rolls are self-centering, or can be made rigid on either side. No springs are used about the machine, an entirely new device being used for weighting the rolls, giving them all the pressure that may be required for straightening the lumber and holding it until sawed. The saw is run close up between the rolls. Guide plates or clamps are used, attached to the feed-roll stands on both sides of the saw, the clamps moving with the rolls. The clamps are not shown in the engraving, but the combination just named suffices to hold the lumber rigid until it has passed by the saw.

A device is also provided for throwing the feed rolls into position, so as to present the lumber to the saw as desired for doing different kinds of work without making any change of spreader, or other parts of the machine. This the sawyer can do while the saw is running, all parts of the feeding mechanism being devised with the purpose in view of enabling the attendant to adjust them as required without moving from the work-end of the machine. The rolls may be set open for any desired thickness by the hand wheel at the end of the machine, and by the same device the board can be removed from the saw, if necessary. The feeding mechanism is moved across the machine by the hand wheel on the side, if desired to slab from the side of lumber and use the self-centering arrangement referred to above. The manner in which the roll stands are connected to the slides is claimed to allow them to work perfectly free at all times.

The makers of this machine affirm that it is capable of performing a larger variety of work (with a notable saving of time) than any other re-sawing machine that is made, and that it has the advantage that any man can run it who is competent to file and keep a saw in order.



CIRCULAR RE-SAWING MACHINE.

The driving pulley on saw is 18 inches diameter, 9 inches face, and should be run at 650 revolutions per minute. The makers furnish counter-shaft when desired, and supply these machines with saws adapted for special work, when this is stated.

Further details may be learned by addressing the manufacturers, the S. A. Woods Machine Co., 91 Liberty street, New York, or 72 High street, Boston.

SURGERY BY THE ELECTRIC LIGHT.—Dr. Berkeley Hill, of London, recently operated for vesico-vaginal fistula in University College, while the vagina was lighted up by Coxeter's application of the glowing platinum wire. The apparatus consisted of a fine wire twisted into a knot. Through this knot was sent a continuous galvanic current, strong enough to maintain the wire at a white heat. The wire was enclosed in a glass chamber, which was itself also enclosed in another glass cover. Through the space between the glasses, a current of water was allowed to flow, in order to preserve a low temperature around the light. A strong light was maintained for over an hour, close to the margins of the fissure, without impeding the operator's manipulations.

Comparative Economy of Gas and Electric Lighting.

Our contemporary, the *Scientific American*, has taken the pains to institute a comparison, based on practical premises, of the cost of gas with electric lighting from the experience gained in one of the largest Eastern factories, (the Riverside Worsted Mills, Providence, R. I.), where the Brush electric lights have been in regular use for about a year. The result of this comparison, our contemporary thinks, is the demonstration of the fact that in spacious apartments, where large numbers of gas lights are required, the electric method of lighting may now be adopted with considerable economy. This inference holds good if the facts are correctly reported, both with the Brush and the Edison systems, as compared with gas lighting. The facts alleged in the case presented are as follows:

In one portion of the mills aforesaid, 1,000 gas lights were formerly used, each of about 15-candle power, yielding therefore an aggregate of about 15,000-candle light, at a cost of (at $2.45 per 1,000 feet) $12.25 per hour, or $^{82}/_{1000}$ of a cent per candle per hour. In place of these 1,000 gas lights, 80 electric lights of the Brush system were introduced, as above noted, each of 2,000 candle power, yielding in the aggregate 160,000 candles, at a cost of 80 cents per hour, or $^{1}/_{2000}$ of a cent per candle per hour. This comparison, presuming that the estimates of cost and amount of light yielded are correct, would show that gas lighting at the mills aforesaid was over *one hundred and sixty times more costly* than electric lighting, estimated on the basis of an equal quantity of light by both methods.

Our contemporary then proceeds to show how Mr. Edison's system of electric lighting will figure in the above comparison, taking as the basis of comparison Mr. Edison's own statements as to cost and efficiency. Mr. Edison, it will be well to notice here, proposes to furnish *small* electric lamps, each having about the intensity of an ordinary gas light of 15 candles, burning 5 cubic feet of gas per hour. He affirms that he gets 10 lamps, or 150 candle light, per hour per horse-power of engine, and that each of his electrical machines furnishes 750 candle light per hour with the expenditure of 5 horse-power.

Applying Mr. Edison's statements to the case of the Riverside Mills above, we would have the following showing: Number of Edison lamps required=1,000; number of Edison machines required = 20; engine power required=100 H. P.; approximate cost of plant =$16,000; approximate cost of running the same, yielding 15,000 candle light per hour (including 6 per cent interest on plant), $1.66 per hour=$^{11}/_{1000}$ of a cent per candle per hour. This estimate of expense, it will be observed, does not allow for the item of royalty to the owners of the patent. It shows, however, that the approximate cost of gas light at the Riverside Mills is, light for light, 7½ times greater than Edison's system; and that the Edison in turn is 22 times more costly than the same amount of light by the Brush system. The relative cost of the several plans is shown below:

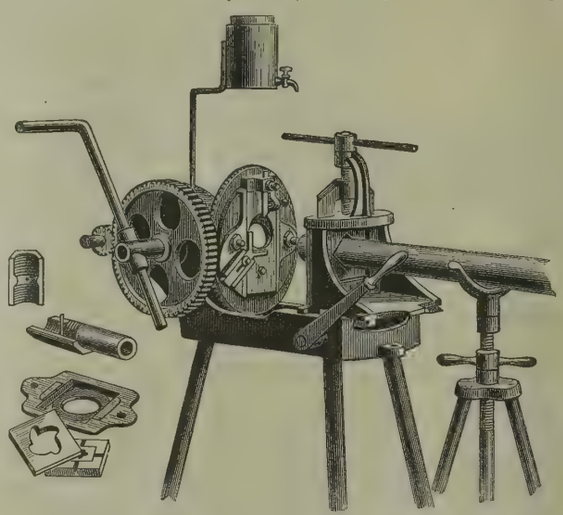
Kind of Light.	Cost per Candle Light per hour.
Gas light	$^{82}/_{1000}$ of a cent.
Edison light	$^{11}/_{1000}$ "
Brush light	$^{1}/_{2000}$ "

The Beet Sugar Industry.

The policy of the State of Delaware in encouraging by means of liberal prizes the cultivation of the sugar beet, promises, as it has already done in Maine, the best results for the establishment of the manufacture of beet sugar on American soil. The production of the sugar beet by the farmers of Delaware, as a consequence of the interest thus directed to the subject, reached the very respectable figures of 600 tons. So favorable was the experiment considered, that a company, called the Delaware Beet Sugar Co., was formed to start the manufacture in the State. Ground was purchased and a factory erected along the line of the P. W. & B. railroad, some four miles from Wilmington. The necessary machinery for the manufacture of beet sugar by the diffusion process was imported, and the factory is now prepared for active work on next season's crop. The capacity of the present works is 25 tons of green beets per day, but this amount can be raised by practicable extension up to 200 tons, as the cultivation of the sugar beet extends throughout the State. We hail this promising experiment in domesticating an important industry in our midst with particular satisfaction.

An Improved Pipe-Cutting and Threading Machine.

A very ingenious labor-saving device, which performs a highly tedious operation neatly and expeditiously, is the improved pipe-cutting and threading machine made by the Chase Machine Co., of this city, and which we illustrate in the accompanying engraving. This machine is simple in construction, and performs its work readily and satisfactorily.



Improved Pipe-Cutting and Threading Machine.

The makers claim that it is the only machine that has automatic cut-off or makes nipples. It is strongly constructed throughout; all the gears are cut, all the parts are made so as to be interchangeable, and the machine can be worked by any available power, adapting itself with readiness to widely varying classes of work. It will operate on wrought iron, gas and steam pipes, boiler tubes, oil well tubes, as well as on brass and copper pipes. The tool will cut out a regular chip in a manner precisely similar to that of a lathe tool, and leave the end of the pipe square and without any projection or ragged edge, either without or within. The thread is cut with great regularity and neatness on all kinds of pipes, from ⅛ to 2 inches inclusive. It is an invaluable machine for steam and gas fitters, and in machine shops, car shops, sugar refineries, distilleries, and wherever there is occasion to cut and thread pipes, bolts and make nuts.

For further particulars and circular, address the Chase Machine Co., 120 Front street, New York.

Improved Saw-File Guide.

The difficulty, not to say impossibility, of sharpening a saw evenly and uniformly by hand filing will be best understood by those who have had some experience at that sort of work. To do it properly requires that the file should be held strictly in the same position for every tooth that is sharpened, and it goes for the saying, that in the hands of one who is inexpert, a saw is more frequently spoiled than sharpened, from the inability of the operator to maintain, by the unaided eye, the proper position of the file for every tooth. The work of sharpening circular saws, from this cause, is even more difficult, and in recognition of the necessity of providing some simple and effective mechanism to control with mechanical accuracy what the most practiced eye and steady hand cannot do unaided, a number of devices have been invented for guiding the file in performing the work of sharpening saws.

One of these that we have in mind, is a mechanical guide of this description, adapted specially for filing circular saws of any diameter and size of teeth. The ordinary hand file—three-cornered, flat, oval or round—may be used, and the device is designed so that when the guide is once set to the bevel and pitch required for the particular saw in hand, it is secured in place, and the most inexperienced workman can be trusted to file the saw with an ease and accuracy that the most practiced hand-filer cannot hope to equal.

In connection with the guide there is provided a table, giving such pitches and bevels as have been found by experience to be the best for the different kinds of saws, and by which the operator sets the guide. The advantage of equal and uniform filing in throwing upon each tooth an equal share of cutting, and insuring that the saw will cut easily, smoothly and rapidly, requires no explanation.

In the special device we refer to, the saw is first adjusted in a clamp, in which it is securely held by a screw which passes through a round wash of the size of the hole in the center of blade, and so disposed as to allow the saw to be readily turned on its center as each tooth is filed at the top of the clamp to the proper pitch and bevel, while a properly disposed gauge keeps the saw true.

Several sizes of this apparatus are made; one for small toothed saws requiring three-cornered files, and another for large toothed saws which require the use of large flat files. A series of holes are provided in the frame of the clamp for the reception of the central screw, thus adapting it for securing saws of different sizes. The apparatus can be applied to straight as well as circular saws, with excellent results and with the minimum expenditure of time and trouble.

The manufacturers are E. Roth & Bro., New Oxford, Pa.

Dyes from Camphor.

Dr. W. H. Gregg, of Elmira, N. Y., is reported to have succeeded in obtaining a new coloring principle from camphor, to which he gives the name of "Laureline." Thus far he has only succeeded in producing various shades of yellow from it; but he is reported to be engaged in certain experiments which he hopes will result in the production of carmine and scarlet. The chief feature of the new dyestuff which recommends it to the attention of textile manufacturers, is in the brilliancy and fastness of the colors.

It can be used upon linen, cotton and silk with no apparent difference in density and brilliancy, and goods thus dyed are said to be entirely unaffected by the ordinary tests to which they will be subjected in use. Boiling for hours in a strong soap solution barely turned the shade of a cotton sample. With indigo, a handsome green is produced.

The inventor is not yet prepared to give special details respecting the cost of producing the new dye, or of the precise methods of using it; but as regards the first item, he intimates that it will be one of the cheapest, and as to the second, one of the simplest coloring matters to make and apply. The textile journals speak in terms of great interest of the new discovery.

American Watches for British Railway Officials.—We are gratified to learn that the American Watch Company, of Waltham, Mass., has secured another contract (the third) for supplying a large number of watches intended for the use of conductors, engineers, station-masters and other employés of the State railroads of India. This contract was obtained in open competition with foreign manufacturers.

The Wardwell Patent Saw Benches.

We describe and illustrate herewith the standard machines well known by the above name, and their extensive introduction throughout the country for a great variety of woodwork, being adapted, as will appear from the description about to be given, for all kinds of pattern, cabinet, and builders' shops where accuracy of sawing is indispensable, the special claim of the machines being such excellence of work that other tools for correcting the finished product are rarely ever necessary.

By an inspection of the engravings, it will be seen that the machine carries two saws, each upon a separate arbor, which arbors are supported in a frame which rotates about a central axis, an arrangement which permits one saw to be at once exchanged for the other, and firmly held in any desired position for splitting, tongueing, grooving, halving, rabbeting, etc. All of these operations, it is claimed, can be so nicely executed that planes and other tools for finishing are rarely necessary.

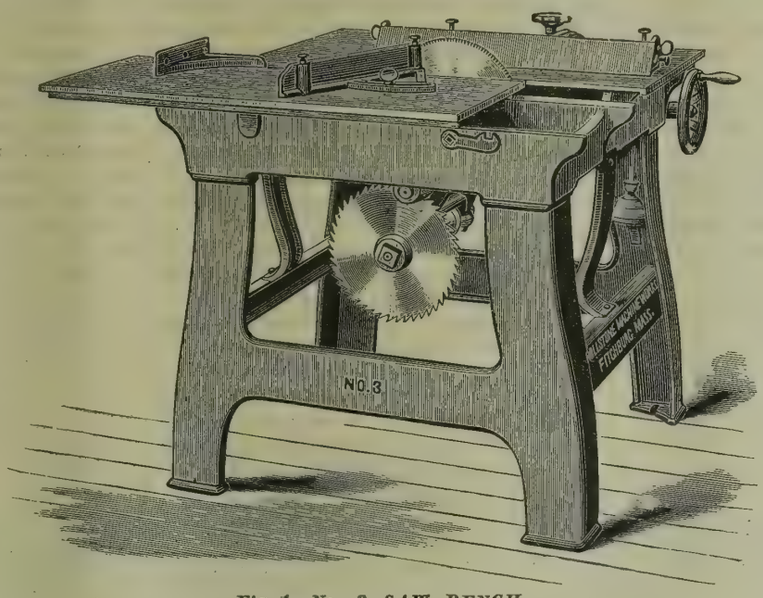


Fig. 1.—No. 3 SAW BENCH.

The left-hand side of the table slides on tracks and carries a rest, which permits it to be set for accurately sawing an octagon, hexagon, square or miter by means of pins and corresponding holes in the table; and quite as readily adjusted for accurately sawing to any desired angle by means of a graduated arc divided and marked into degrees, over which the cutting-off fence swings and is fastened at pleasure. The splitting fence, carried on the right-hand part of the table and sweeping its full width, can also be adjusted to split any angle from a square to a miter.

A series of light cutting-off gauges are furnished with the machines when desired, which may be used on one or both sides of the saw for such work as picture-frames, etc.; they are also constructed to be used with plowing and dadoing heads, which may be readily adjusted to cut various depths.

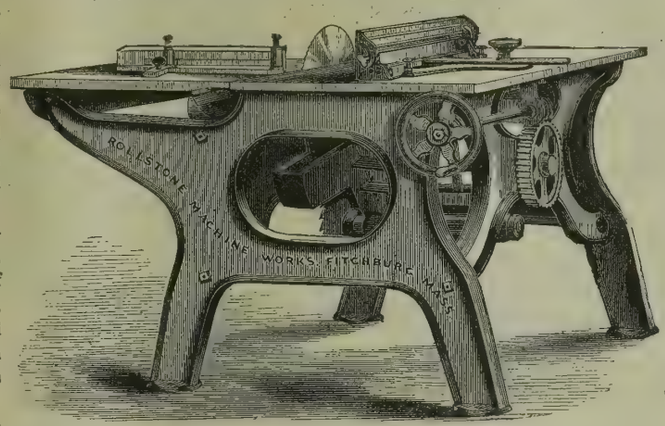


Fig. 2.—No. 4 SAW BENCH.

One of the best attachments of the machine is that for sawing out circular forms, for work like core boxes, lagging, etc., by which the hollow part of a core box, for example, can be so nicely sawed that a little sanding with a sand roll is all that is required to finish it. The position of the saws, it may be added, is regulated by using the handwheel seen on the front of the frame.

These machines are constructed of several sizes, provided with steel arbors, ground bearings, wide belt pulleys, etc. The engravings show three sizes of the machine, the important details of which are herewith given.

Fig. 1 is the saw bench No. 3, table 36 inches square, carries two 12-inch saws, with sliding table 16 inches wide. This is a very desirable machine for pattern, cabinet and light work generally where perfect accuracy in sawing is desirable. It miters, bevels, grooves and performs all the operations necessary in the above named shops. Driving pulleys 6½ inches face; weight, 650 pounds.

No. 4 (Fig. 2) is heavier than No. 3, has a table 4 feet square, and carries two 14-inch or one 20-inch saw. It is for carpenter and other shops where a No. 3 would be too small. It has the angular, splitting, grooving and dadoing appliances same as No. 3. Driving pulleys 3½ inches diameter, 7-inch face; weight, 1,100 lbs.

No. 5 (Fig. 3) is for shops where very heavy work is required. Table, 51 inches square; carries two saws from 12 to 16 inches in diameter, or a single saw of any size up to 26 inches. Driving pulleys 4 inches in diameter, 8 inches face; weight, 1,500 pounds. It has the angular and splitting rests, and grooving and dadoing appliances, same as No. 3, and when wanted, an extension table, as shown in the cut.

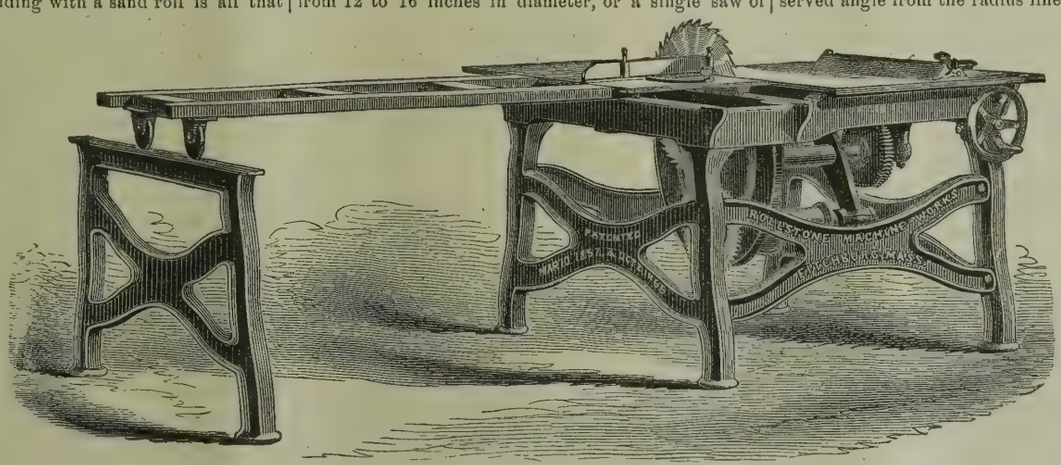


Fig. 3.—No. 5 SAW BENCH.

These machines are manufactured by the Rollstone Machine Co., of Fitchburg, Mass., who may be addressed for further information.

The Topophone.

The report of the United States Lighthouse Board, just published, contains a description of a new apparatus invented by Prof. A. M. Mayer, called the Topophone, or "sound placer," which, if we may judge from the published statements of experiments made to test its merits, promises to be of special service to mariners, by placing at their disposal an instrument that will give them the exact direction of sounds emitted by fog horns, fog bells, and the like.

The construction and application of the apparatus will appear from the following description: It consists of a vertical rod passing through the roof of the deck cabin of the vessel, and bearing on the upper end a horizontal bar carrying two adjustable resonators, below which a pointer is set at right angles with the bar. Rubber tubes from the resonators pass through the roof of the cabin and unite in a single pipe connected with a pair of ear tubes. The vertical rod is turned by means of a handle in any direction. The first step is to tune the resonators accurately to the pitch of the sound under observation, and fix them at a distance from each other somewhat less than the length of the wave of that sound; the next, by turning the handle, to bring them simultaneously on the wave surface, when, as they both receive at the same instant the same phase of vibration on the planes of their mouths, the result will be that, if the connecting tubes be of the same length, the sound-pulses, acting together, will be reinforced to the ear; but, if the tubes differ in length by one-half of the wave-length of the sound, the pulses will oppose and neutralize each other, and thus tend to produce silence. At this moment the horizontal bar is a chord in the spherical wave-surface of which say the fog horn is the center; and the pointer represents a radius, or, in other words, coincides in alignment with a line drawn from the place where the sound is produced through the place of observation. By sailing the ship at a measured distance at an observed angle from the radius line thus found, a second radius line may in like manner be found, and the distance between the two points of observation is the base-line of a triangle, of which the two convergent radii are the sides. From these data the distance of the fog horn is readily computed.

Provided with this apparatus, several members of the Lighthouse Board proceeded to Sandy Hook, where they landed and caused the fog horn to be put in action, and turned to a fixed note for convenience of adjustment, and then proceeded in the "Mistletoe" to various distances from the shore, and made numerous experiments to determine how closely a person seated in the cabin could turn the apparatus so as to indicate the true direction of the sound. It was

thus shown that any one, by simply turning until the least sound was perceived, would bring the pointer to within less than one point of the true direction. This degree of accuracy was all that was requisite in the practical use of the apparatus.

On the following day they again went in the "Mistletoe" to Eaton's Neck, on Long Island, where they repeated the same experiments, with like results, finding that, at distances from four to six miles, it was easy to determine the direction of the horn from the vessel to within one point. In the course of these experiments, certain improvements in detail suggested themselves, and these have been embodied in a new apparatus constructed by Mr. French, with which Prof. Mayer has been making further experiments, with a view of perfecting its details.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

An extensive two-story addition is being built upon the New York Life Insurance building, at Leonard street and Broadway.

On Sixty-ninth street and Madison avenue six houses are to be built for Anthony Mowbray. Two will be of brick and stone, and four of brown-stone.

At Nos. 21 and 23 West Twenty-six street, an office building is to be built for the Astor Estate. It will be of brick and granite. Thomas Stent is the architect.

On Greene street, corner of Houston, a 60 feet front store is to be built of brick and terra-cotta, at a cost of about $35,000. Gambrill & Ficken are the architects.

On White street a store, 25x76, is to be built from designs of J. Slade, to cost about $20,000. The first story will be iron, and above that brick and stone will be employed.

At the northeast corner of Broadway and Franklin street, the foundations are being laid for a brick and stone store, 50 feet front and 150 feet in depth and five stories in hight. It is expected that the building will be finished early in the Autumn. S. D. Hatch is the architect.

A brick and free-stone building is nearing completion at the southwest corner of Broadway and Clinton place. It is five stories in hight, 100 feet in depth and divided on the ground floor into two stores twenty-four feet wide. It is owned by the Sailors Snug Harbor Association.

At the northeast corner of Grand street and Broadway an iron structure of six stories, running through to Crosby street, is being built by George Bliss & Frederick H. Corsitt. The building will comprise two stores of fifty feet front, with freight and passenger elevators, and will be ready for occupation about June 1.

Work has just been commenced on a "flat" to be built on the corner of Fifty-second street and Broadway. The building will be eight stories high, the first story will be stone, above brick and terra-cotta. The style is Queen Anne, and the cost will be about $120,000. Ferdinand Meyer is the owner. Lamb & Wheeler are the architects.

Thomas F. Treacy has recently begun the construction of five houses, two on One Hundred and Sixteenth street, near Third avenue, and three on Lexington avenue, corner One Hundred and Eleventh street. These houses are only 20x55x100, and are finished in the most approved style, special attention having been paid to plumbing arrangements.

Breen & Nason, have just completed six first-class houses on the south side of Sixty-sixth street and two on the north side of Sixty-first street, all between Madison and Fifth avenues. Two of the Sixty-sixth street houses measure 25x98x100 and the two others measure 25x62x100, the Sixty-first street houses being also of the latter dimension. The basements are finished in hardwood, the first floors in mahogany, walnut and oak, the second floors also in hardwood, and the third and fourth floors in pine.

The Liverpool & London & Globe Insurance Company have decided to erect a large building. They have purchased the real estate 47 and 49 William street and 41 and 43 Pine street for $175,000. The present buildings thereon will be torn down on May 1. The new building will be of brick, fire-proof, six stories high, with two elevators and with passages and entrances on both streets. It will have a front on William street of 60 feet, and on Pine street of forty feet. The Company will remain in their present building, 45 William street, until the new building is finished, when the old one will be altered to correspond with the new one and made a part of it. The total cost of the work, including the real estate, will probably reach $350,000.

The First National Bank and the Bank of the Republic have decided to erect at the northeast corner of Broadway and Wall street a large structure for their joint occupancy, to be known as the "United Bank Building." This will cover the site on the corner now owned and occupied by the Bank of the Republic, and the adjoining buildings, No. 92 Broadway and No. 4 Wall street. The building No. 94 Broadway, in which the First National Bank is now situated, is owned by the Astor estate and will not be included in the alterations. The new building will measure 71 feet 8 inches on Broadway, by 91½ feet on Wall street, and will cost more than $500,000. The first story will be occupied by the offices of the two banks, and the rest of the building will be rented for the offices of lawyers, brokers, etc. The work of tearing down the present buildings will begin on the 1st of May.

The Mechanics' and Builders' Exchange is now daily crowded with builders and contractors, and according to their expectations a very busy Spring and Summer is foretold. The plans for new buildings, comprising brown stone residences, French flats, tenement houses, and any number of stores, deposited at the Public Building Department, are far more numerous for the first three months of this year than has been known for many years. The buildings contemplated being built, and for which plans have been deposited will cost nearly $2,000,000, and in addition there are numerous houses that are to undergo alterations, involving an enormous outlay. The members of the Exchange have not, as yet, taken any action in regard to the question of raising the wages of the different employés in the building trade, but will do so in a few days, so that there may be no difficulty when active operations are begun during the present month. A large number of the members are in favor of an increase in pay, but are opposed to the eight hour law being forced upon them.

Miscellaneous.

A church is to be built at Cleveland, O. It is the Case Avenue Presbyterian Church, to be built of stone, at a cost of $25,000. Joseph Ireland is the architect.

The Southern Pacific Railway Company is building a three-story hotel, 400 feet long, in the Monterey Grove at Monterey, Cal.

The Masons of Newport, O., contemplate building a grand temple, and are negotiating for the purchase of the lot on the northwest corner of Mayo and Saratoga streets.

A botanical laboratory is building for the Michigan State Agricultural College, at Lansing, Mich., from designs prepared by Watkins and Arnold, architects; cost, $6,500.

A new opera house is to be built at Bangor, Me.; the seating capacity will be 1,234. The building will be on Main street, and the work will probably begin at once.

It is reported that a new hotel of magnificent proportions is to be built on Exchange street, Buffalo, N. Y., by a stock company, on the land east of the Washington block.

Two new school houses are to be built during the coming summer at Indianapolis, Ind., one on the corner of East Vermont and New Jersey streets, the other will be on Beeler street, near Seventh.

A new library building is also to be built at Indianapolis, Ind. The building will be 120x39½ feet, two stories high, constructed of brick and stone. The estimated cost is $14,000.

The contract for the new hotel which is to be built at Manhattan beach has been awarded to E. Snedicor, of Brooklyn, for the sum of $228,000. Steam radiators are to be placed in all the rooms. This is a decided innovation in a sea-side hotel, no other house of the kind having such a convenience. There will be two elevators for the convenience of guests. The furnishing of the hotel will cost $75,000. The building will be ready for guests June 15th,

Extensions of Industrial Establishments.

A large cotton-mill is to be built at Fishersville, N. H.

The Sturtevant Woolen Mills at Niantic, Conn., are to be rebuilt.

Joists are being laid for the first floor of the Rosalie Yarn Mill at Natchez, Miss.

J. S. Richardson has commenced the foundations for his new mill at Montague, Mass.

A three-story addition, 40x50 feet, is to be made to the Chaffee Mill at Moodus, Conn.

The Troy Blanket Mill Co. are immediately to enlarge their mills at Keene, N. H.

An addition, 60x50 feet, is building to the Parker Spoon Works at East Meridan, Conn.

The Flint Mill Corporation at Fall River, Mass., is preparing to build a cotton house.

The Bridgeport Cartridge Company of Bridgeport, Ct., is to build an addition 60 feet long.

Collins' shoe manufactory at Danville, N. H., is to be enlarged to double its present size.

The Union Rolling-Mill Company of Chicago, Ill., will soon build a large wire mill at a cost of $300,000.

A building 70x40 feet is to be built in place of the old suspender factory at Oakville, Conn.

The works of the Danforth Locomotive & Machine Company at Paterson, N. J., will be rebuilt.

The proprietors of the new paper-mill at Piqua, O., are getting ready to put up their buildings.

Ira G. Briggs & Co. of Voluntown, Conn., are about to enlarge the Beachdale Mill, by an addition 42 feet in length.

The 6,000 spindle addition to the Natchez Cotton Company's Mill, at the same place, is about to be placed under contract.

Inskip, Austin & Buck are preparing to build a three-story brick flouring mill, corner of West and Beach streets, Hillsboro, O.

The Quinebaug Company of Danielsonville, Conn., will probably build a two-story brick mill, 96x445 feet, at a cost of about $60,000.

The Whittenton Manufacturing Company of Taunton, Mass., is building a new weaving mill 360x151 feet, one story and full basement.

The cotton factory at Brunswick, Me., is to be enlarged, and the box factory rebuilt. About twenty tenement houses are also to be rebuilt.

It is said that the Jessup & Moore Company will spend almost three-quarters of a million upon their new paper-mill at Wilmington, Del.

A dye house, 60x100 feet, is about to be built for the Waterloo Manufacturing Company at Waterloo, N. Y., from designs of J. Morgan Slade, of New York.

John B. Munn, of Northampton, and Charles Baush, will build a foundry near the river road, below Chase's lumber yard at Holyoke, Mass., 80x40 feet in size, with two smaller ones.

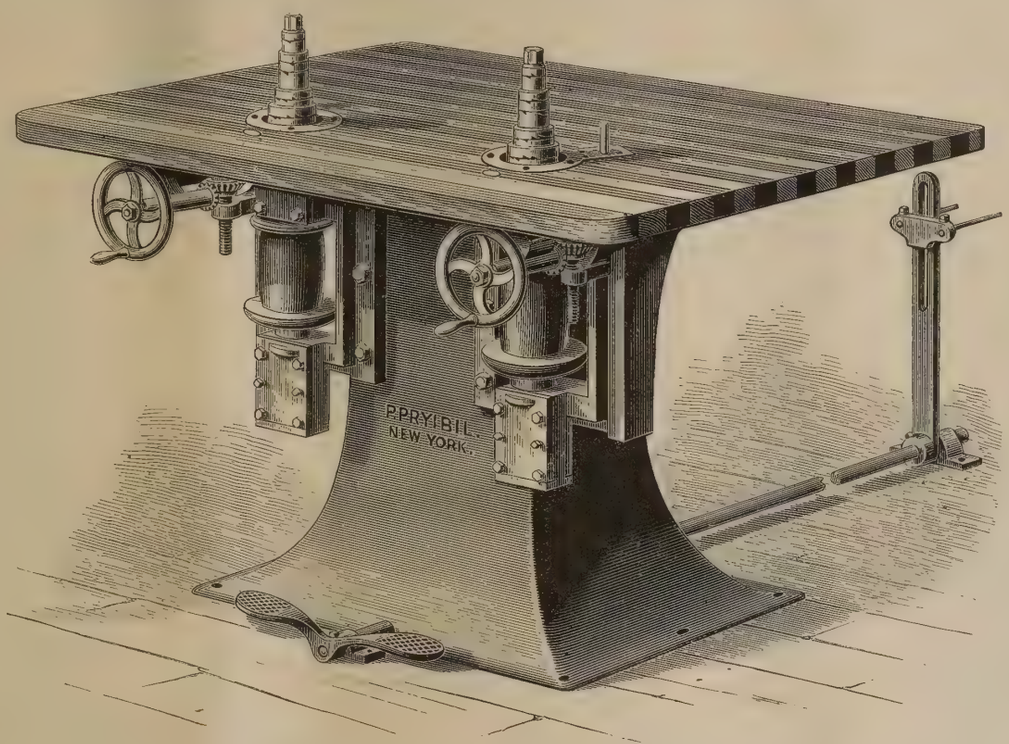
S. Bent & Bros., chair manufacturer at South Gardner, Mass., are at work on the foundation for a new factory, the main part to be 54x40 feet, two stories high, with basement.

Knowles, Taylor & Knowles of East Liverpool, O., have concluded contracts for their large additions, which will require 1,000,000 of bricks, 175,000 feet of joist, and 45,000 feet of flooring boards. The new buildings will measure 110x223 feet.

Two-Spindle Shaping Machine.

The machine herewith illustrated, is, with the exception of the well-seasoned wooden table, constructed entirely of iron and steel, and is so designed as to insure the production of the finest work, while possessing great strength and avoiding those defects and dangers so common to machines of its class. The credit for the improvements which have been combined to effect these results is due to its manufacturer, Mr. P. Pryibil, of 461 to 467 West 40th street, this city.

Referring to it in detail, we would state that the body is cast in one piece, affording a strong and perfectly rigid frame—proof against straining or twisting, however uneven the floor on which it is placed, or however much the floor may vary from any cause, such as the piling of lumber at the side of the machine. To the top of this body, and to brackets bolted thereto and planed perfectly true therewith, forming altogether an unusually large surface, is firmly bolted the wooden table, which, through its direct connection with the body of the machine, is insured against vibration. Around each spindle is let into the table an iron ring of about 10 inches in diameter; to this ring are fitted two reducing rings, for the purpose of reducing the size of the holes to suit the work to be done. Iron tables are furnished when required, but as a rule practical men prefer the above.



TWO-SPINDLE SHAPING MACHINE.

The spindles, which should run at from 4,500 to 5,000 revolutions per minute, are of steel, and are fitted with steel nuts running on right and left hand threads. These spindles run in long babbitted boxes, which, for the purpose of keeping them always perfectly in line, are cast with connecting skeleton frames. These frames, together with the boxes and spindles, are raised or lowered without the intervention of thumb-screws or lock-nuts, by screws provided with hand-wheels placed conveniently at the operator's hand, just below and back of the front edge of the table. The bearings are self-oiling, the caps being provided with an oil chamber filled from the top, and containing a wick in contact with the spindle and running nearly the whole length of the bearing. This arrangement affords a more economical and at the same time a more uniform and efficient lubrication than could be accomplished by hand. The lower bearings are extended downward and chambered out, forming oil wells, in the bottoms of which are placed steel steps, upon which the spindles run.

All the box caps are made very deep and are fitted into the boxes to an unusual depth, thereby insuring a parallel adjustment and obviating the necessity of packing.

Accompanying each machine are two wrenches, four reducing rings, five sets of collars, all below 2¼ inches being made of steel, and an iron belt-shifter, controlled by a treadle placed conveniently at the operator's feet, just back of the edge of the table. The counter-shaft is provided with self-oiling adjustable floor standards and self-oiling loose pulley.

Two sizes of this machine are made, one for heavy and one for light work.

Strikes in Massachusetts.

The Eleventh Annual Report of the Massachusetts Bureau of Statistics of Labor, recently presented to the State Senate, contains an account of all the strikes which have occurred for fifty years past. The number of strikes and lock-outs included in this record is 159. Of these, 35 occurred in Boston and its annexes, 14 in Lynn, 10 in Lowell, 9 in North Adams, 8 in Fall River, 4 each in Worcester, Chicopee and Marlborough; 3 each in Taunton, Natick and Blackstone, and the remainder scattering through 41 towns. The facts are brought out that 76 of these strikes were effected chiefly by workmen of foreign birth, and that of these 159 strikes, 59 were among textile operatives, 34 in shoe factories, and 10 among builders, while the remainder were distributed in small numbers among 25 industries. More than two-thirds of the strikes (109) were unsuccessful. Only 18 are recorded as wholly successful, 16 as compromised, and the result of 9 is unknown. In respect to the causes of strikes, 118 were to secure better wages, 24 for shorter days, 9 to enforce trades union rules, 5 to resist employers' rules, and 3 against the introduction of machinery. The moral drawn from these statistics is that strikes generally prove powerless to benefit the condition of the wages class; they tend to deprive the strikers of work; they lead to improvidence, and are demoralizing in their effect upon the working man. Reference is made to the strikes in Great Britain and Ireland during 1877–78, aggregating 468, of which less than 20 were successful, and about 30 compromised.

A New Varnish for Protecting Metallic Surfaces, especially those of iron, we glean from the *Engineering and Mining Journal*, is believed to have been found in the application of euphorbium gum. The history of this suggestion is stated to be as follows: The workmen of Natal are said to have noticed that when they cut certain plants of the *euphorbiaceæ*, a thin, adherent layer of gum remained upon the tool which effectually protected the blade from rusting. To determine the extent to which the protective influence could be relied upon, the experiment was tried of coating sheet-iron with the gum and immersing it in the sea water of South Africa, which is highly detrimental in its action upon iron. The trial is affirmed to have proved so successful that a varnish was made of the gum dissolved in spirits, and this was applied to ships' bottoms and to other metallic surfaces. The adherence of the gum after the evaporation of the spirits is said to be perfect. A two-years' trial of this preparation at the Chatham dockyard, in England, is reported to have given equally satisfactory results, the iron so varnished having remained uninjured after exposure, during that period, to the corrosive action of the water of the docks. In Africa, where the gum is abundant, it is said to have long been in use as a preventive of the ravages of the white ant. Its virtues are ascribed to its perfect insolubility in water, and to its poisonous qualities and extreme bitterness, which make it an excellent protective agent against the lower forms of marine and terrestrial life.

The Way of the Striker.

The New York *Tribune* records an almost amusing illustration of the peculiar ways of strikers, coming from the mines of the Houtzdale (Pa.) region. The coal miners demand an advance of 10 cents per ton; and this might be granted if the operators could have assurance that it would finally settle matters. But there have been nine strikes in three months. First, they struck for a check weighman, upon the plea that the operators were cheating them. This was granted with the proviso that the weighman should be paid by the men themselves. Then they struck to have the said weighman placed upon the company's pay roll, and carried that point. Then the drivers struck for an advance of 25 cents per day, and got it. Then the trappers struck for an advance of 10 cents per day, and got it. Then the miners struck for 10 cents per ton advance for mining, and got it. Then the drivers struck for an advance of 25 cents per day, and for "ten hours," and got both their claims allowed. Then the miners organized the present strike, and the drivers propose to follow suit. In view of these constant and repeated demands, the operators have come to the conclusion that it is necessary to draw the line somewhere. In fact, if the thing is to go on, the mines themselves might as well be deeded as a free gift to the workmen, for it is impossible to carry on any business successfully, or even intelligently, if wages are thus to be kept uncertain, and always on the rise at that.

Useful Application of the Telephone.—The telephone has been found by Herr Niemöller capable of determining very quickly and accurately the resistance of liquids. It is substituted for the galvanometer in a galvanic bridge, and an induction current is used; then, if the resistances compared are a large liquid resistance on the one hand, and a Siemens resistance box on the other, so that the electro-dynamic constants of the branches are very small; if, further, a German silver or platinum wire be used as measuring wire, it is found that in the position where the galvanometer shows no deflection, the tone in the telephone has a well-marked minimum of intensity. Supposing the liquid resistance has 2,000 units, a variation of even 4 units reveals itself in a displacement of the minimum position.

Contributions to the Causes and Prevention of Boiler Explosions.

We present our readers this month with the history of another boiler explosion, attended with circumstances of special interest, which we glean from the instructive sheet—*The Locomotive*—issued by the Hartford Steam Boiler Inspection and Insurance Co.:

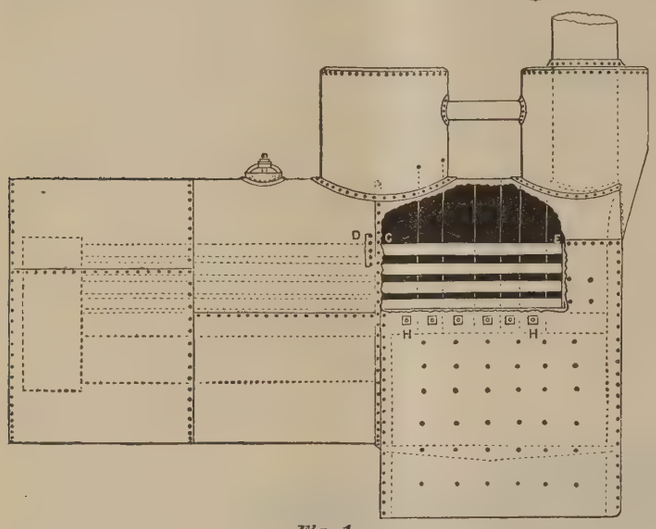


Fig. 1.

The boiler of the tug-boat "Popham," which exploded near Bath, Me., October 14, 1874, was of the type commonly employed in American towing service, varied by having a steam dome in addition to the usual steam chimney. The dome was placed behind the steam chimney and connected to it by a steam pipe near the top; it was seated about half on the crown of the body and half on the top of the barrel. The boiler was about 14 feet long over all, and the barrel 6 feet diameter by 9 ft. long, made of $^{5}/_{16}$ in. plates. It was allowed to carry 60 lbs. of steam, and was about eight years old at the date of the accident, which occurred while towing a raft of logs. It contained two furnaces, which delivered their gases through separate cylindrical horizontal flues into the back connection, whence they returned through a bank of horizontal tubes to the uptake and chimney in front. The sheet that formed the top of the semi-cylinder of the body joined the sheets of the sides by a single riveted horizontal seam, at about halfway between the crown fastenings of the vertical stays on the shell and the upper line of furnace side stays. After a few years a leak came to light at the junction C of the horizontal and girth seams. A patch was applied, as seen at D, Figs. 1 and 3; bolts also were passed through the body from side to side, as seen at H H and C, Fig. 1 The portion of the shell bounded by this line of bolts and the flanges of the two domes, blew out, and the part above the seam, about 4½ feet long, turned upward, hinging on its upper line of supports, and struck the domes with such violence as to leave the marks of the points of the attached rivets indented on the domes, and the blow was sufficient to tear it free, so that it was lost overboard. Its form is shown at B, Fig. 3. The part from below the seam A, Fig. 3, turned downward, hinging on the lower line of supports, and remained on board, striking in its flight the adjacent coal bunker of the vessel with force sufficient to bend it into the form of a gutter, A, Fig. 3. The appearance of the vent C E attracted attention, and on close inspection, while a critical examination into the quality of the metal of the broken sheets was progressing, conducted by the local inspector of steam boilers for the district, the regular line of fracture, C E, was discovered to be an old crack, well marked by old oxide for a considerable part of the length, and nearly through the plate in several places, shown in Fig. 4, in cross section. The opening had an area of more than a dozen square feet, and of course terrible havoc was made of everything in the path of this powerful mass of expanding water. The fireman, who was on deck passing a line, was blown overboard among flying parts of the wreck, and instantly killed.

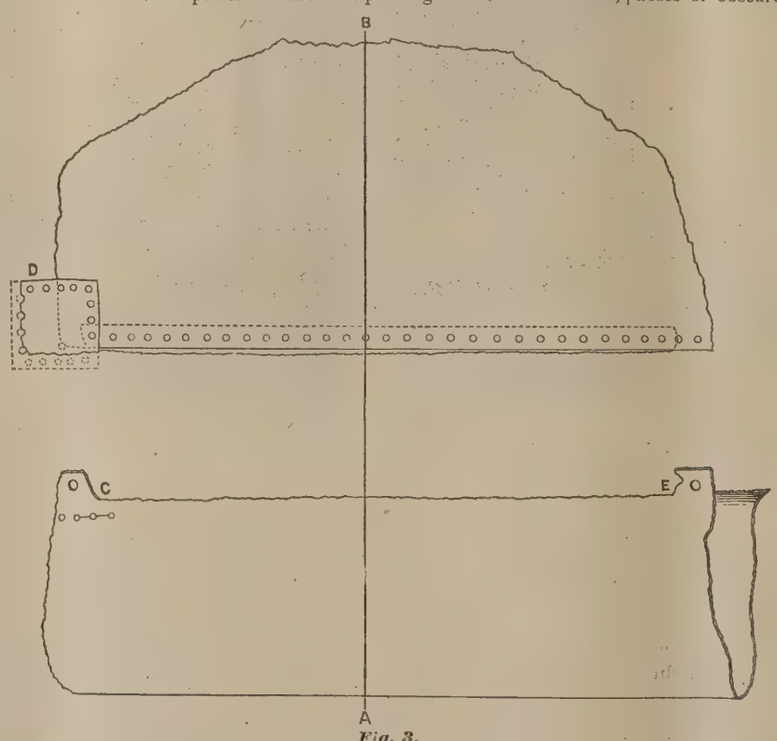


Fig. 3.

After the patching and the bolting, the boiler was regularly tested, but no discovery of the weakness was made until after the disaster. Had those in charge of this boiler fully understood the significance of a leak in such a place (D), they would hardly have rested satisfied with the hydrostatic test alone, or with patching and bolting in this manner. As the physician can obtain the faculty of making correct diagnoses of obscure diseases only by carefully attending to ante-mortem symptoms and post-mortem examinations, so the engineer must solve the mysteries of boiler accidents by studying defunct structures of many different types.

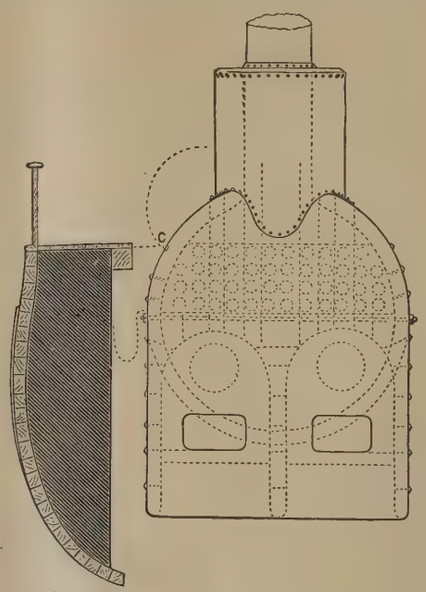


Fig. 2.

[The dark shading is a section of the coal bunker.]

Fig. 1 is a side elevation of the boiler, showing the opening caused by the explosion. Fig. 2 is a front elevation, showing the location of the defective seam at C, and the cross stay bolts below the opening; also section of the side of the vessel and the coal bunker. Fig. 3 is a diagram of the pieces that were blown out, drawn to a larger scale, C E the line of initial rupture, and D the patch. Fig. 4 is a sectional outline of the ruptured plates on the line A B, Fig. 3, omitting the parts of the plates between the ruptured edges, showing the location of the old crack and the character of the secondary ruptures at the ends of the diagram, drawn full thickness of the plates.

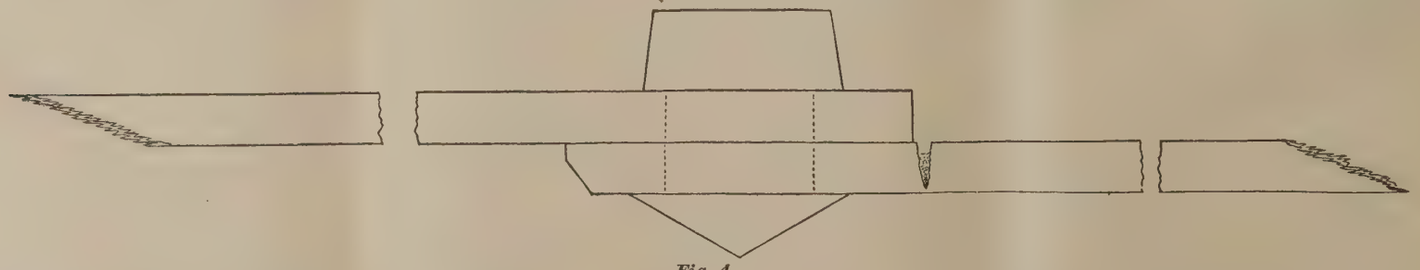


Fig. 4.

South American Exhibition.

The United States Consul at Buenos Ayres, announces that a Continental Exhibition will be opened in that city on September 15, 1880, to continue until December 15 of the same year. The exhibition is to be divided into six sections. All the nations of South America can contribute to and compete in the exhibition; but the United States and Europe are limited to one section for machinery only. The usual directions to exhibitors have been published in pamphlet form.

Cams.*

The term "cam" is applied to a curved plate or groove which communicates motion to another piece by action of its curved edge. A plate of this kind is shown in Fig. 1, in which, for the sake of illustration, we will suppose that the portions *a b*, *c a*, are any given curves, and that *b c* is a portion of a circle described about the center of motion. It will be obvious from

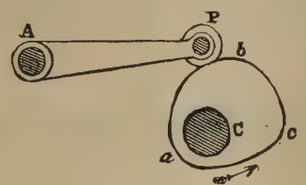


Fig. 1.

an inspection of the figure that as the plate or cam rotates in the direction of the arrow, the roller P at the end of the lever A P will be raised gradually by the curved portion *a b*, will be held at rest while *b c* passes underneath it, and, finally, will be allowed to fall by the action of *c a*.

In this way a cam may be made to impart any required motion, and may reproduce in machinery those delicate and rapid movements which would otherwise demand the highest effort of skill from a practiced workman.

The circular motion being uniform, the reciprocating

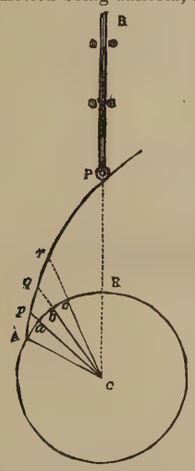


Fig. 2.

piece may also move uniformly, or its velocity may be varied at pleasure.

1. Suppose that the reciprocating piece is a sliding bar, the direction of which passes *through the center of motion* of the cam plate; take C (Fig. 2) as this center, let B P represent the sliding bar, and let A be the commencement of the curve of the cam plate. The curve A P may be set out in the following manner: From the center C describe a circle having the radius

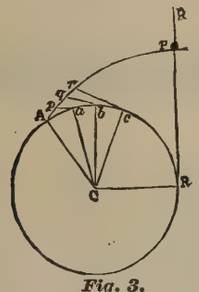


Fig. 3.

C A, and let B P produced meet its circumference in the point R. Divide A R into a number of equal arcs A *a*, *a b*, *b c*, etc.; join C *a*, C *b*, C *c*, etc., and produce them to *p q r*, etc., making *a p*, *b q*, *c r*, etc., respectively equal to the desired movements of B P in the corresponding positions in the cam plate; the curve A *p q r* . . . P will then represent the curve required. This curve will often present in practice a very irregular shape; but in the particular case where the motion is required to be uniform, it assumes a regular form.

2. Suppose that the center of motion of the cam plate lies upon one side of the direction of the sliding bar. In this case the method of setting out the curve will change accordingly, to wit.: Suppose, for example, that the direction of B P (Fig. 3) passes upon one side of the center of motion C, draw C R perpendicular to B P produced; describe a circle of radius C R, and conceive the motion to begin when A coincides with R. Divide A R into the equal intervals A *a*, *a b*, *b c*, etc., and now draw *a p*, *b q*, *c r*, etc., tangents to the circle, and equal in length respectively to the desired movements of B P during the corresponding periods of motion of the cam plate. The curve A *p q r* . . . P will be that required.

The illustration (Fig. 4) shows how, by means of cams, it is possible to produce any required movement. The principle of this combination of cams will be understood from the following description: The bars in the figure have fixed centers at A and B, and it is apparent that if we were to remove the cam and fasten the joint at R to the plane, we should be able to give P a vertical movement by the swing of the arms A E and R D. In the same manner, if we fastened E to the plane and liberated R, the arm E P could swing about E, and the point P would then describe a small circu-

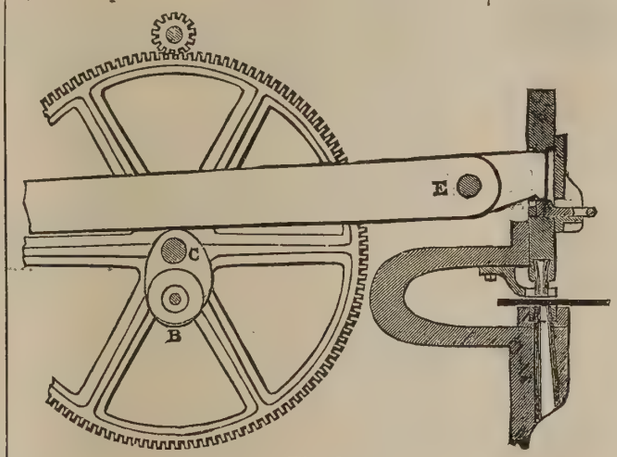


Fig. 6.

lar path which would closely approach to a horizontal line. Suppose now that these bars are connected with the cam, as in the engraving, and press the pointers at Q and R against the curves of the respective cams. Let these cams be revolved slowly about a center C (shown in the smaller cam plate) in the direction of the arrow, and the required letters will be traced out by the pencil. The combination shown in Fig. 4 will trace out the letters R I; the sketch shows the letter R just finished and the pencil about to trace out the tail of the letter I. The darkened portions of the cams are arcs of circles about the center of motion where nothing is being done, the pencil remaining at rest while the cam rotates through a small angle.

This example illustrates the fact that a combination of two cam plates, actuating a simple frame-work of levers, will enable us to command any movement in a plane perpendicular to the axis of rotation. We shall presently see how to obtain a motion parallel to the same axis, thus securing any required movement in space.

The heart-wheel, which is much used in machinery, is formed of the union of two similar and equal cams of the character discussed in the earlier portion of this article. A curved plate C (Fig. 5), shaped like a heart, actuates a roller P, placed at the end of a sliding bar, or, as in this case, attached to a lever P A B, centered as at A, and connected by a rod B D to the reciprocating piece. The peculiar form of the cam allows it to perform complete revolutions and to cause an alternate ascent and descent of the roller P with a velocity which may be made quite uniform. Since a cam of this kind will only drive in one direction, the follower must be pressed against the curve by the reverse action of a weight or spring.

Fig. 6 shows a practical application of a cam similar to that just described, to a lever punching machine. The cam is here shown attached to the axis of the

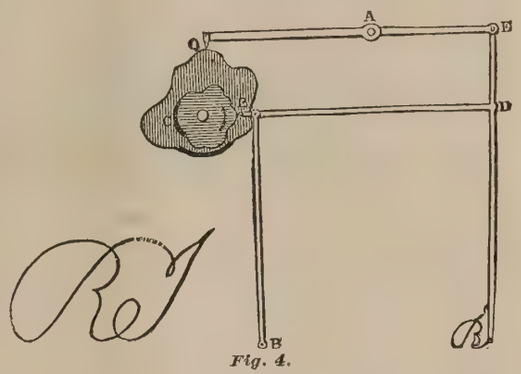


Fig. 4.

driving wheel, and the lever, which carries the punch in a slide connected with its shorter arm, is centered on the pin at E. The curve of the cam in this case is so adapted that it shall raise the longer arm of the lever bar in one-fourth of a revolution of the driving shaft, allow the lever to fall in the next one-fourth, and finally leave the punch raised, as shown in the engraving, during the remaining one-half revolution, thereby giving the workman an interval of time to adjust his piece before the next hole is punched.

(*To be Continued.*)

The Artificial Diamond Controversy.—The English journals describe the "diamonds" manufactured by Mr. Hannay (and for the identity of which we printed last month Prof. Maskelyne's unqualified endorsement), as small crystallized particles which easily score deep grooves in polished sapphire. So far as it has been possible to measure them, the cleavage angles are believed to be practically identical with those of the diamond, and the artificial product, ignited on a strip of platinum foil, glows and disappears precisely as the mineral diamond does. These statements are interesting as supplementing our notice of last month. The details of the procedure have not yet appeared, the only statement on that point being to the effect that the process will form the subject of a paper to the Royal Society.

Hight of Factory Buildings.—It is thought that before long the cotton mills of New England will be built

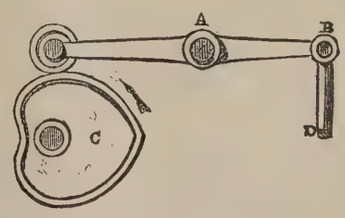


Fig. 5.

with one story, instead of with five or six, as at present. The advantages claimed, are increased safety and convenience, and a higher speed for machinery. The report of a New England gingham factory on last winter's use of a one-story building, was that it covered about an acre, was built of brick with corner towers, at a cost of $23,000, and saved in gas alone a sum equal to the interest on the cost of the building. The looms were driven at 12 per cent higher speed than on the second floor of the old mill, the repairs were fewer, and less imperfect work was turned out.

*The illustrations to this series of articles are taken from Goodeve's "Elements of Mechanics," (D. Appleton & Co.), from which also the text has been substantially reproduced.

Files and File Manufacture.

FILE SHAPES.

Files and rasps vary greatly in length, width, lineal outline and cross section, no one of these elements having any bearing upon the other. Most files and many rasps have a "tang" or "tine," generally (where hand-made) misshaped, and causing misfit in the handle and frequent falling out of or splitting the latter,

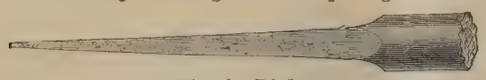


Fig. 1.—Right.

especially as file handles are generally badly shaped and put on, and one handle is used for different kinds and lengths of files. Shoe and horse rasps usually have no tang. Where the section is circular the shoulder should be nicely tapered from a sweep made from the heel, as shown in Fig. 1, and not directly start from the full section, as in Fig. 2. When the section is rectangular, the tang should have a rounding shoulder, as in Fig. 3, and not a square one as Fig. 4, as in this latter case there are apt to be fire cracks, and breakage is more likely in case of a fall.

Purchasers should be very careful to insist on this point. It is partly bull-headedness on the part of manufacturers to continue to put the old square shoulder on the market, and partly a false economy, as they

Fig. 2.—Wrong.

wish to "avoid the expense of changing dies." At least this is the reason advanced by a maker of hand-made files. *Per contra*, the machine-made file manufacturers say that as the dies have to be repaired or remodeled every few weeks, this statement will hardly hold water. Refusing to buy square shouldered tangs will convert unprogressive makers to modern and improved pratice.

Now, as regards contour or linear outline, files may be "taper," which means having a swelling taper from the point, one-half to two-thirds the length; or "full taper," having this taper extend to the heel—"blunt," which means parallel; or "equaling," which means blunt with a very slight swell in the center. A file may have one of these contours in width and another in thickness—that is, it may be parallel in width and taper in thickness.

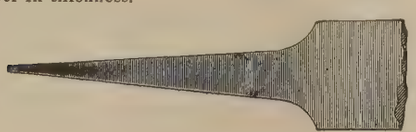


Fig. 3.—Right.

Where the file is to be used on flat surfaces, purchasers should insist upon files being convex from point to tang, as in Fig. 5, and not merely from point to center, as Fig. 6.

The sections of steel bar from which files are made, are round, triangular or rectangular, and modifications or combinations thereof. Half-round are not semi-circular, but cover only 120°. "Pit-saws" are for gulleting pit-saws. Half-round files are not economical to use, because in the average machine-shop use, two flat sides are used up to one curved, the flat side giving out first. Half-round rasps are in common use by wood and brass workers, plumbers, and marble work-

Fig. 4.—Wrong.

ers. Round files generally taper considerably; their use ranges from gulleting briar-tooth saws in the small sizes, to ship-yard, railroad, engine, and bridge building for the larger.

A flatter section than the half-round is the "cabinet"† (Fig. 10), so named from its principal use by cabinet-makers. One section usually (or at least frequently) made higher than the pit-saw (which it resembles), is the "high back."

The triangular sections are very common, the so-called "three-square" (of 60° angles) being especially well known. This last section is used in rolling mills and machine shops, and for saw-filing. With one angle of 108° and two of 36°, it is the "five-cant" for filing M toothed saws. "Six-canted," or having one angle of 120°, it is used for hexagonal nuts, wrenches, etc. With a 12° angle it is useful to gunsmiths for lock springs, and to small gear-wheel makers for spur and pinion teeth.

Quadrangular sections range from square (equal sides and 90° angles) through proportionally thinner and thinner sections, to "warding."

Square files are generally very taper, and are used for enlarging rectangular holes; but with parallel sides they cut key-ways and mortises.

Pillar sections (Fig. 11) have one side nearly double the other, and cut grooves for keys or cotters, etc.

The "hand" section is proportionally thinner, and a very common style. It is generally bellied in side contour and nearly parallel in width, and used for finishing flat surfaces.

The "flat" section is thinner than the hand, and generally goes with taper sides and edges. Still thinner is the "mill" (Fig. 12),‡ used in machine shops for lathe-work and draw filing, and for brass and bronze finishing. The thinnest section is the "warding," first used for cutting key-wards, and hence having sides generally parallel in thickness, but tapering in width.

Among miscellaneous and combination sections are the "cross," § having curved faces, unequally convex; "feather-edge,"‖ four-sided, and thinner than the "knife edge"; "shoe rasp,"¶ like a "cabinet," with truncated edges; "reaper,"** (Fig. 13), having two parallel sides and two inclined edges—all flat; and the "tumbler,"†† equally curved on both sides, but not so flat as the "cross." The "roller" is still used for fluting cotton machinery rollers.

The "riffler," Fig. 7, is decidedly convex on the cut side. Fig. 8 is a "slim taper" hand-saw file of extra length, and, for many reasons, preferable to the regular taper. The *double-ender* taper (Fig. 9) is shown with its special handle.

The most important and practical improvements and innovations in file shapes, are those introduced by the Nicholson File Co., of Providence, R. I. This company, striking out boldly from old prejudices, and treating file-making and file-using from a practical and progressive stand-point, has achieved a remarkable success from a business and a technical point of view. In this, of course, they would not have succeeded had they not exercised the most scrupulous care in the selection of material and the various stages of manufacture. Every prominent improvement noted in this article is adopted by them—most of them by that company solely, and in many cases the company is the originator and pioneer in introduction.

Our next article will treat of the various grades and styles of file teeth, and the mode of producing them.

† Covering 72°, or one-fifth of a circle.
‡ So called from its principal use in filing mill saws.
§ Sometimes miscalled "double half-round." Handy where there are two differently curved flutes required in the same work.
‖ Once used for making curry-comb teeth and sear springs of gun locks.
¶ Prevalent form now. The French still use a double elliptical curve shoe-rasp section.
** Use obvious from name.
†† Now of little use. Once used on gun-lock tumblers.

The Coming War Ship.

Prof. Lœwenthal, we learn from certain of our technical contemporaries, thinks that the coming war ship will be made of India rubber. His idea is to make the entire hull of rubber one foot in thickness, strengthened below the water line by a light steel frame. The vessel will be driven by an ordinary steam engine, and will have no masts. At the bow will be a projecting spar, to which torpedoes will be affixed, and the entire crew, including the helmsman, will be on the lower deck out of the range of shot. When a cannon ball strikes the India rubber ship, it will pass directly through it above the heads of the crew, and the hole

Fig. 5.—Right.

made by it will instantly close. Paying no attention to such futile attacks, the India rubber vessel will steam toward her adversary and explode her torpedo. The doomed vessel will instantly sink, while her elastic destroyer will be driven hundreds of yards backward by the recoil following the explosion. Such a vessel, says the inventor, could destroy all the navies of the world, and after her work was done she could be made as strong as ever with the aid of two or three bottles of cement.

Dynamo-Electric Machines in Telegraphy.

We are enabled to chronicle this month a highly important innovation in telegraphy, which promises very speedily, from all accounts, to effect a complete revolution in the economies of telegraphy throughout the world. This is nothing less than the substitution of dynamo-electric machines, driven by steam, as the source of electrical current for telegraphic purposes, in place of the chemical battery cells that have, up to the present time, been universally employed for the purpose. To accomplish this result has been the aim and effort of many able electricians, but up to the present time they have been attended with but indifferent success. The accounts given, however, of the invention of Stephen D. Field, of San Francisco, Cal., and the action of the Western Union Telegraph Company in introducing his system into the headquarters of telegraphy in this city, point to the fact that what had been so long essayed in vain, has been at length accomplished.

Fig. 6.—Wrong.

Fig. 7.—Riffler.

The immense advantages that will be attained by the substitution of steam-driven electric machines for the battery cells, will appear from the following general considerations. In the year 1873, the Western Union Telegraph Company sent 14,456,832 messages, at a cost of $6,575,055; and in 1879, 23,070,106 messages, at a cost of $6,160,200, showing that while the amount of business had almost doubled during the period above named, the operating expenses, by reason of the introduction of improvements and the greater perfection of details of the art, had been even slightly reduced. And a careful estimate of the working expenses of this company is reported to show that while the cost for battery per mile of wire for operating, was, in 1873, $\$1.17^{1}/_{10}$, this had been reduced in 1879 to $\$0.34^{1}/_{10}$, in the face of the fact of the enormous increase in the

amount of work done. Such is the confidence, however, in the success of the present improvement, that it is already confidently asserted that by the substitution of the dynamo-electric machines for the battery cells, a further diminution of the present cost of supplying the electric current, of at least 50 per cent, will be effected.

From the published accounts that have appeared respecting this new departure, we condense the following facts, which will serve to render the leading principles involved in it, comprehensible to our readers. The process is not a new one, but it is a successful adaptation of a well-known means to a new purpose. Previous experiments in the same direction have failed, as it now appears, for the reason that the force was procured by running a single dynamo-electric machine to its utmost tension, instead of supplying the power by a number of connected machines run at a moderate and even rate. The attempt first succeeded at San Francisco under the management of Stephen D. Field, who has been in charge of the experiments at the office of the Western Union Telegraph Company in this city for several months. At present there are three Siemens generators in operation, run by a 12 horse-power engine, although two actual horse-power is quite sufficient to do the work. The three generators are small, containing less than 600 feet each of No. 12 copper wire in their coils. They are not a new invention, but are regarded as the most suitable generators for the purpose that have yet been produced, on account of their compactness and simplicity. The armature is a hollow cylinder of soft iron, with brass heads, mounted on a shaft, carrying the driving pulley, about which the 56 iron wires are wound, and covered by the insulated conducting wires wound transversely. The terminal wires are soldered to the bars, and the armature revolves between the poles of a field magnet, while its commutator cylinder is touched at the ends by the brushes, which take off the fluid. The armatures are in the telegraphic circuit, and the wires of the field magnets are in connection with the exciting power. This is the principal difference between the present arrangement and that employed in other magneto-machines.

Three sets of these machines are at present on trial in the battery room of the Western Union Telegraph Company's building, after a thorough test of several months in San Francisco had demonstrated to the satisfaction of telegraph engineers and operators that the system was successful. Two sets are used for working the 360 wires radiating from the company's building, and the cables of the gold and stock telegraph, while the third set is held in reserve. Fifteen generators of 20 or 30 per cent more power than the present ones are being constructed, and will be immediately placed in position. Their force, measured by their lighting power, will be about 1,500 candles each. They will be run by three engines of 5 horse-power each, although only 6 horse-power in all will be used on the average. Not more than two engines and ten generators will be used at one time, the rest being held in reserve.

This power will entirely replace 14,300 gravity element cells and 4,600 bichromate of potash cells, known as line battery, and about 600 cells used in local work. The present batteries weigh about 72 tons, and occupy an enormous space; the new device will occupy very little room, giving a great gain in space, and will not weigh in all more than 12 tons. All the generators will be so connected that any one or other may be released or added, as a greater or less power may be required, the first machine in the series having an electromotive force of 50 volts, and each successive one in the series having an increased power, so that in a series of ten the last would have a tension of 500 volts. Extra force will be supplied as at present at all grounding points by relays, as the chemical or battery electricity can be made to assist the mechanical electricity. Less than three months will be necessary to complete all the changes, and in a very short time it is expected that the new method will be adopted not only at all important central telegraphic points in America, but will be generally accepted throughout the world.

Fig. 8.—6-Inch Slim Taper Hand-Saw File.

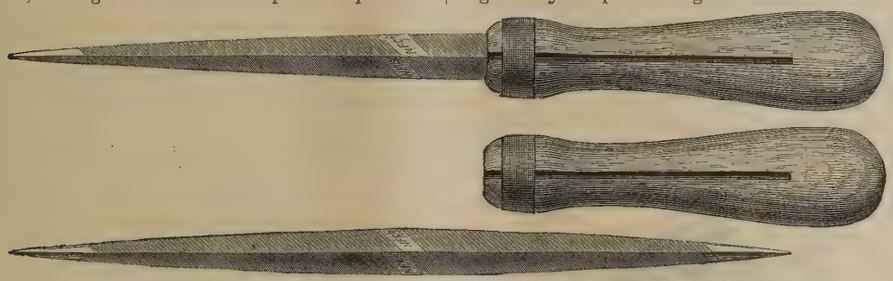


Fig. 9.—"Double-Ender" Hand-Saw File and Special Handle.

Flooding the Colorado Desert.

We glean from the *Mining and Scientific Press*, of San Francisco, the following interesting details of an ambitious project, which General Fremont, at present Governor of Arizona, has been urging upon the attention of the general government, in connection with other enterprises calculated to promote the prosperity of the territory. The project in question embraces a plan for flooding the Colorado desert, and of converting it into a great inland sea, by opening a passage from the Gulf of California, and allowing the water to enter and overflow a large area in the southeastern corner of that State, and we presume also some portions of the northern part of Lower California, inasmuch as the head of the gulf lies a long way south of the line, and wholly in Mexican territory. The area of country to be inundated is represented as being 200 miles long and 50 miles wide, this new body of water to have an extreme depth of 300 feet.

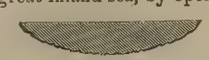


Fig. 10.—Cabinet.

Fig. 11.—Pillar.

Fig. 12.—Mill File.

That this project is not only feasible, but easy of accomplishment, admits of no doubt, the district which it is intended to submerge lying below the level of the gulf, from which it is separated only by some slightly elevated ridges, said to be depressed in places almost to sea level. The question is not so much one of financial and engineering difficulty, as of economical and sanitary considerations, fears having been expressed that the flooding of such a shallow basin, with its marshy borders, would breed enough malaria to endanger the health of the regions adjacent; the query also being suggested whether it would be good policy to convert this district, desert as it is, into a vast expanse of salt water merely for the beneficial effects it would be likely to exert on the climate of the surrounding country and the facilities it would afford for inland navigation.

That the presence of so large a body of water would tend to moderate the temperature of this, the hottest and dryest section of California, admits of no doubt. This lake would also open navigation to vessels of deeper draft than can now ascend the Colorado. But what business would there be for vessels on a lake like this, surrounded by sterile regions, destitute alike of agricultural and mineral resources? There are mineral-bearing lodes far to the north, on both the California and Arizona sides of the Colorado; but none, so far as we know, within a hundred miles or more of the site of this proposed inland sea. Unlike the Mohave desert, adjoining it on the north, this so-called Colorado desert produces much grass—so much, in fact, that with water for stock, it would really be a valuable grazing district. As it lies so low, a great deal of it being depressed from 50 to 300 feet below the sea level, it is probable that good water could be obtained by artesian boring—very likely, merely by digging. What little water there is near the surface is generally bad being impregnated with alkaline, saline, or other substances of an injurious kind. At greater depths, it would no doubt be more plentiful and of a better quality. The railroad company have, we believe, got good water at several points on this desert by boring, and that without going to very great depths.

With railroads traversing these deserts, such inland navigation as a lake of this kind would afford, becomes of less importance, provided, always, there were any local carrying of consequence to be done, which, as before remarked, there is not. The Southern Pacific road crosses this great arid basin diagonally and on its longest axis, affording every needed facility for supplying it with goods and shipping its scanty exports. Not much need for steamers circumnavigating the peninsula to perform this service.

It will be observed that this plan for introducing the salt water of the gulf upon these dry lands, and covering them up altogether, forms no part of the scheme of Dr. Wozencraft, who, on the contrary, proposes to irrigate them with water brought in from the Colorado river, and thereby convert them into a great tobacco, rice and cotton producing region—an enterprise quite as feasible and seemingly more desirable, in an economical point of view, than this more recent and novel enterprise of the "Great Pathfinder."

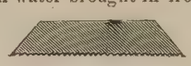


Fig. 13.—Reaper.

A New Tool.

We observe in the English technical journals an account of an interesting novelty in files for working soft metals and wood, which is worth reproducing. The file in question is the invention of the Messrs. Kirkwood of Leith-Walk, and was lately exhibited and described before the Scottish Society of Arts.

The file, according to account, is formed of about 200 separate plates of steel, connected by an iron bar passing through them, and bound together by a screw. The advantage claimed for it, is that all filings of soft metals or wood, can be got rid of by simply loosening the screw, and thus separating the plates, which can be done without difficulty or inconvenience. One of these files, it is claimed, will last three years, immensely surpassing the common file in point of wear, and re-

presenting a corresponding saving in outlay for this indispensable tool. It is also claimed for it, that it performs quicker and better work than the cut files in ordinary use.

An Improved Thermo-Electric Battery.

If the number of solutions that are proposed for a problem establish the measure of its importance, we must give the highest rank to the economical and practical production of electricity. The methods thus far known and employed for this purpose may be divided into three great classes; namely:

1. The transformation of chemical action into electricity. This is one of the oldest methods, and is still the most common.

2. The conversion of mechanical energy into electricity. In this direction immense progress has been made within the last few years. For this purpose, however, it is necessary to have a motive power at

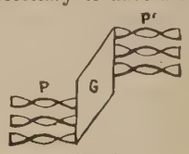


Fig. 1.

disposal.

3. The direct conversion of heat into electricity. This method of solution, while it may not be the most economical, is certainly the simplest, and the new apparatus of M. Clamond, which we describe in the following paragraphs, is the most perfect thermo-electric battery that has been constructed up to the present time. As long ago as 1874, M. Jamin exhibited before the French Academy an improved thermo-electric battery by the same inventor; but since that time M. Clamond has greatly perfected his apparatus, and has brought it to the condition in which we find it to-day.

A few words explanatory of the conditions to be realized in a thermo-electric battery will not be amiss in introducing a description of this apparatus.

A thermo-electric battery is formed of a series of elements, each composed of two heterogeneous substances soldered together at one of their extremities. By uniting a great number of couples, so formed by soldering together the extremities of each couple of different substances, a thermo-electric chain or series is formed. By heating all the soldered pairs located on one side, and by cooling all the solderings on the other, an electric current is generated in this series, the electro-motive force or tension of which depends: 1st, on the difference of temperature between the two series of solderings; and 2d, on the nature of the substances that compose each element.

It has required years of patient and learned research to ascertain the best substances to employ, the relative dimensions to give to the couples, to dispose them so as to obtain the best results from the application of heat to one of their extremities, and from the cooling of the other, to avoid the deterioration of the elements by a badly distributed heat, which would have the inconvenience of melting the solderings, and thus rendering the pile unserviceable.

M. Clamond, however, in his latest apparatus, appears to have met these complex conditions very satisfactorily. This apparatus, which is shown in perspective, and partly in section, in Fig. 4, is composed of three parts: (*a*) The furnace and the collector, the design of which is to heat the interior solderings of the pile; (*b*) the pile, properly so called; and (*c*) the diffuser, the purpose of which is to cool exterior solderings.

The Furnace and Collector.—The battery is heated by means of oil or coke. The combustion products, after leaving the fire-place, traverse a cylindrical conduit C, Fig. 4, descend in D by a series of passages disposed in annular form, as shown, reascend by a second series of such passages shown at E, and finally escape into the atmosphere through the chimney A. The combustion products, therefore, do not

Fig. 2.

heat the elements of the pile by direct contact, but simply serve to heat the metallic surfaces of the parts in which they circulate, which in this manner constitute a "collector" of heat, and communicate it to the elements. This arrangement is affirmed to give the best results in utilizing the heat of the furnace.

The Battery.—The battery proper is composed of a series of chains disposed round about the "collector," so as to receive its heat on their interior faces. In the battery of 3,000 couples there are 60 chains of 50 couples each. Each couple consists of a thermo-electric bar or prism of 3 centimeters in width and 2 centimeters in thickness. These little prisms are composed of an alloy of bismuth and antimony, and are united by means of armatures of iron, shown in Fig. 1. These armatures are cut in the form of small plates of sheet iron, and twisted spirally at their extremeties P and P'. To make a thermo-electric chain, a series of these armatures is placed in a special mold, after having surrounded the part G with a sheet of amianthus cardboard, and the parts P and P' of each armature are then united successively by an autogenous solder. This procedure presents the advantage of giving a perfect union, and is economical. The thermo-electric current

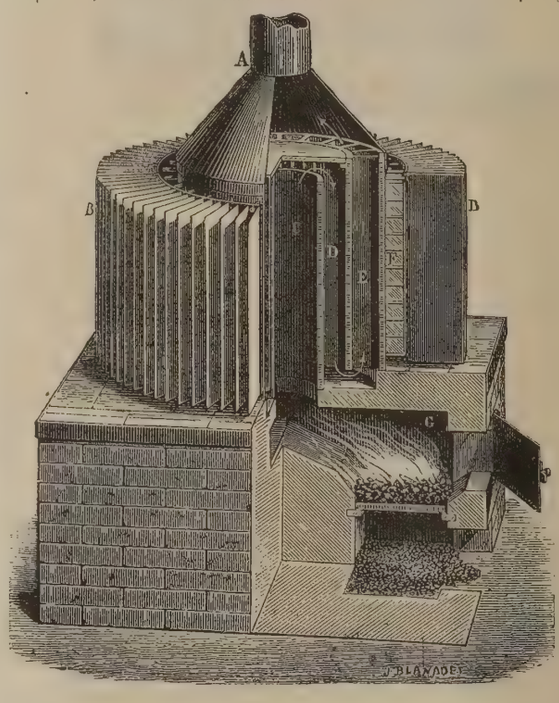


Fig. 4.

is generated by heating the face P of the couple and cooling the face P'. One series of couples forms a chain in which the armatures are supposed to have been removed. When the chains are finished, thin plates of mica are attached on the faces which are to be subjected to heating and cooling, as will appear from a glance at Fig. 3. The chain is then placed in T, the part A of the apparatus constituting the "collector," intended to heat most advantageously the interior face of the chain, and the part B constituting the "diffuser," the role of which consists in performing the opposite function of cooling the exterior face.

The chains are generally cast in series of 50 couples. Each chain of 50 couples, then, represents a single element, the poles of which are at each extremity, and which may be united with the next chain either in tension or quantity. The pile of 3,000 couples, therefore, constitute in reality a battery of 50 elements, which may be combined like the elements of an ordinary chemical battery, according to the service one has in view.

Most frequently, as these elements have a very weak interior resistance, and a feeble electro-motive force, they are grouped in tension. A pile of 3,000 elements grouped in this manner, represents, according to M. Cabanellas' experiments, an electro-motive force of 109 volts (about 60 Bunsens), and an interior resistance of 15.5 ohms. The average temperature of the interior solderings is about 360° C. (651.2° F.), and that of the exterior solderings does not exceed 80° C. (147.2° F.).

The Diffuser.—In order to secure as low a temperature as 80° on the exterior solderings, M. Clamond

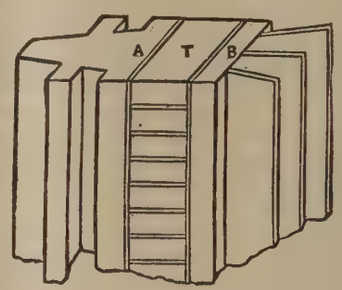


Fig. 3.

finds it desirable to employ the device to which he applies the name of "diffuser." This consists of a series of plates of copper placed all about the battery, and which effect the removal and rapid dispersion of the heat of the solderings by means of the great surface which they present. To avoid metallic contacts of the battery, either with the "collector" or with the "diffuser," which would close the pile on itself, and consequently suppress the electrical current, the outer face of the "collector" is surrounded with a sheath composed of thin plates of mica; and the interior face of the "diffuser" is similarly provided. These mica plates, while they interpose only a very slight obstacle to the propagation of heat, form, nevertheless, an excellent insulator of electricity.

The thermo-electric battery of M. Clamond, as described in the foregoing, constitutes a very economical source of electrical power. The largest apparatus thus far constructed is made up of 6,000 couples, and consumes 9 to 10 kilograms (20 to 22 pounds) of coke per hour. When arranged in two circuits of 3,000 couples each, this apparatus is able to feed two of Serrin's lamps, yielding a light varying from 30 to 50 carcels (600 to 1,000 candles) for each lamp.

The consumption of 10 kilograms of coke for the production of an average of 80 carcel lights is still too expensive to render it an economical source of electricity for lighting purposes; but the invention of M. Clamond is such a decided advance in the direction of the direct conversion of heat into electric energy, that further and even more remarkable results may not unreasonably be looked for in the near future.

We glean the facts and illustrations for the foregoing article from the pages of *La Nature*, to which we refer for their correctness. As our readers will perceive, any substantial progress in the solution of the problem of generating electricity by the direct transformation of heat, is of the first importance.

Underground Telegraphs in France.—Following the example set by her neighbor across the Rhine, France is about to inaugurate a system of underground telegraphs. A credit of eight million francs has been asked for, for the establishment of subterranean wires along some of the main trunk lines, to take the place of the existing aërial lines. The total length it is proposed to lay down at this time is about 295 kilometers (about 184 miles).

Scientific.

Concerning the Sun.—Prof. Charles A. Young, the eminent spectroscopist, has lately given in one of our contemporaries (the *Princeton Review*), a masterly review of the present condition of our knowledge of the sun, and of the most recent additions to our knowledge of solar physics and chemistry, from which we summarize the following facts of very general interest and value.

The special attention of recent investigators has been directed to the solution of problems relating to the distance and mass of the sun, its constitution, its radiation and temperature, its atmosphere, and its appendages of chromosphere and corona; and in every one of these directions the skill and patience of investigators, aided by the greater perfection of instruments and accuracy of methods employed, have resulted in considerable additions to our knowledge. The recent correction in the value of the solar parallax, for example, marks a very decided advance in the study of the sun, since it has given us a more correct estimate of his distance from the earth, a value upon which many and highly important astronomical calculations are based. For more than forty years the only calculation of the solar parallax upon which astronomers could rely was that of Encke. He gave it a value of 8.58″, from which the mean distance of the earth from the sun is found to be a little over 95,000,000 miles. Later researches have shown Encke's value to be somewhat erroneous, and different computations were made, which resulted in giving the solar parallax a value of 8.80″ to 8.90″, corresponding to a mean distance of 92,900,000 and 91,800,000 miles respectively. Until quite recently, astronomers have accepted the value 8.85″ as being the most accurate; but within a year, the classic researches of Mr. Gill, the British astronomer, and Lieut. A. Michelson, of the U. S. Navy, have given as a result a value of 8.78″, corresponding to a mean distance of the earth from the sun of 93,100,000 miles.

Respecting the sun's temperature, there have been wide differences of opinion. The estimates of Secchi and Ericsson have placed it as high as several millions of degrees, while those of the French physicists, Violle and Vicaire, have placed it as low as 2,000° C.

Two important contributions to our knowledge of this important factor have lately been added, one by Prof. Langley, of Pittsburgh, and the other by Prof. Rosetti, of Padua. The former, while not committing himself to figures, has demonstrated that the solar heat is far higher than the most intense artificial heat; and Rosetti, as the result of an elaborate investigation, gives 10,000° C. (about 18,000° Fah.) as the effective temperature of the sun. This result, Prof. Young believes, should be accepted as more worthy of confidence than any hitherto reached.

On the subject of the chemical constitution of the sun, the most important contribution to our knowledge has been the recent demonstration by Dr. Henry Draper of the existence of a non-metallic element—oxygen—in the solar atmosphere. Dr. Draper's conclusions, based upon photographic evidence, it should be noticed, have been opposed in some quarters, but the great weight of evidence appears to be in his favor. Prof. Young believes "there is reason to hope that the photographic method may in the near future give us satisfactory proof of the presence in the sun of still other non-metallic elements, such as nitrogen and carbon, the absence of which has been hitherto a great puzzle to astronomers." Mr. Lockyer's theory, however, does not favor this conclusion. His researches have excited great interest in the scientific world, and have been the subject of earnest discussion. He claims that the non-metallic bodies are not elementary, but compound, and that many of them could not exist in the intense heat of the sun without separating into their constituents. The truth of this theory, in the opinion of Prof. Young, "can hardly be considered as at present established—at any rate it is still warmly debated and disputed among chemists and physicists, and by some who are neither; but it certainly has attained considerable credibility, and the evidence in its favor seems to be accumulating."

M. Janssen, who has done much valuable photographic work at the Meudon Observatory, near Paris, has found that the surface of the sun presents areas of distinct vision, separated from each other by streaks and patches, in which everything is confused and indefinite. There is no doubt that these are actual solar phenomena, and not mere defects of the photographs. Another interesting fact is that pictures made at an interval of some hours show important changes and different details on the sun's surface.

Important results in another department of solar photography have been attained in England by Captain Abney, who has gone further than any other observer in photographing the rays at the lower end of the spectrum. When his methods are perfected, it is expected that this part of the spectrum may be studied with the same advantage as the ultra violet.

In the opinion of a majority of astronomers, the eclipse of 1878 has proved that an intimate connection exists between the state of the sun's surface and the condition of the corona. Whether the sun-spots have any influence upon the earth, and especially upon terrestrial meteorology, is a question which has lately been much studied, but upon which observers are not agreed. Prof. Young expresses the opinion that observations from all parts of the world, and covering several sun-spot periods, are necessary to form the foundation of any safe conclusion. The connection between the sun-spot period and the magnetic state of the earth has been regarded as established for the past thirty years. Recently, however, it has been questioned by the distinguished French astronomer, Faye.

Artificial Diamonds.—Although important details are still wanting, and will doubtless not be given to the scientific world until the reading of his promised paper to the Royal Society, the English technical journals give the general features of Mr. Hannay's process with sufficient detail to make the general principles of his method comprehensive. From the information that has appeared on this topic, Mr. Hannay's process is at once original and interesting, and, aside from the results he has attained, it opens up a new direction for future chemical research and discovery. The facts of the case, so far as they have been given to the public, appear in what follows, which we give on the authority of the London *Athenæum:*

In the course of researches "On the Solubility of Solids in Gases," which have formed the subject of two papers read before the Royal Society, the author, Mr. J. B. Hannay, of Glasgow, conceived the possibility of finding a solvent for carbon. A gaseous solution nearly always yields crystalline solid on withdrawing the solvent or lowering its solvent power; it was, therefore, probable that the carbon might be deposited in the crystalline condition. Many experiments were made, but they showed that ordinary carbon, such as charcoal, lampblack, or graphite, is not affected by the most probable solvents that could be thought of, for chemical action takes the place of solution.

During these experiments, Mr. Hannay noticed a curious reaction—namely, when a gas containing carbon and hydrogen is heated under pressure in presence of certain metals, the hydrogen is attracted by the metal, and the carbon is left free. When this takes place in presence of a stable compound containing nitrogen, the whole being near a red heat and under several thousands of atmospheres of pressure, the statement is made that the carbon is so acted upon by the nitrogen compound that it is obtained in the clear, transparent form of the diamond. (Just what role is played in this operation by the aforesaid nitrogen compound, is at present quite unknown to the writer.) The great difficulty lies in the construction of an enclosing vessel strong enough to withstand the enormous pressure and high temperature, tubes constructed on the gun-barrel principle (with a wrought-iron coil), of only half an inch bore and four inches external diameter, being torn open in nine cases out of ten.

The carbon obtained in the successful experiments is as hard as natural diamond, scratching all other crystals, and it does not affect polarized light. Crystals have been obtained with curved faces belonging to the octahedral form, and diamond is the only substance crystallizing in this manner. The crystals burn easily on thin platinum foil over a good blow-pipe, and leave no residue, and after two days of immersion in hydrofluoric acid they show no sign of dissolving, even when boiled. On heating a splinter in the electric arc, it turns black—a very characteristic reaction of diamond.

Lastly, a little apparatus was constructed for effecting a combustion of the crystals and determining their composition. The ordinary organic analysis method was used, but the diamond crystals were laid on a thin piece of platinum foil; this was ignited by an electric current, and the combustion conducted in pure oxygen. The result obtained was that the sample contained 97.85 per cent of carbon—a very close approximation, considering the small quantity employed.

The announcement that the long-predicted experiment—artificial formation of diamond—would be described at a meeting of the Royal Society, has occasioned much excitement; but neither dealers in diamonds nor the general public need disturb themselves. The process is expensive, tedious and dangerous, and the diamonds produced as yet are too small to represent anything beyond a scientific value.

Nevertheless, supposing the foregoing statements to be completely verified, and we have no reason to doubt their substantial correctness, the production of the diamond in quantity in the laboratory has now resolved itself simply into a question of time.

Explosion of Carbonic Acid in a Coal Mine.—The singular circumstance of a veritable explosion caused by carbonic acid, is reported by M. Delesse to have occurred in the coal mine of Rochebelle. The event was attended with two explosions, following each other at an interval of less than a minute. Two miners at work in a shaft at a depth of about 1,100 feet, heard the reports, which were instantly followed by the extinguishment of their lamps, and a feeling of great oppression. They were brought to the surface in safety; but several of their companions who had been at work in the galleries, were not so fortunate—three lives were lost. It was at first supposed that the explosion had been caused by fire damp, but the bodies and clothing of the victims showed no sign of fire, neither had the loose gunpowder and cartridges been ignited. No fire damp had ever been observed in the mine, but occasional outbursts of carbonic acid had been noticed, and guarded against by special provision for ventilation.

The locality of the explosion showed a hole of a capacity sufficient to have contained about 76 tons of coal. M. Delesse, who investigated the subject, is of opinion that the cause of the explosion must be attributed to the action of sulphuric acid (generated by the oxidation of iron pyrites) on the underlying beds of limestone, to which it was carried by the percolation of the subterraneous water. The carbonic acid gas generated in this manner, he conceives, penetrated the crevices of the coal, and by its accumulation at length produced sufficient pressure to burst through a confining barrier of coal with the violent and disastrous effects above noted. This disaster is probably unique. The suffocating effects of the after-damp, carbonic acid, resulting from the explosion of the fire damp, is a well-known and frequent cause of disastrous loss of life; but an explosion attributable primarily to carbonic acid under the circumstances here narrated, is, so far as we are aware, unprecedented.

Photographs of the Moon.—Mr. George Berwick has taken a series of photographs of the moon on very sensitive plates—the bromo-gelatine. One of the plates shows three well defined rings around the moon. Wheth

er the rings are due to cosmical, atmospheric, chemical or optical causes is not yet determined.

How Billiard Balls are Made.

There is probably no manufacture, says the Boston *Journal of Commerce*, that shows better the wonderful skill of the human hand, guided by the human brain, than that of billiard balls. It is really a "manufacture," in the true and original meaning of the term, "made by the hands," for their true spheres are produced entirely by the hand without the aid of any formative mechanism.

The teeth of the sperm whale, the tusks of the walrus, and the horn of the narwhal are sometimes called ivory, but incorrectly. Only the elephant, the living species and the fossil, or mammoth, furnish true ivory —at least in amount sufficient for commercial purposes. The tusks, when imported, vary greatly in size, weight and shape. Some are perfectly straight, while others, the fossil or mammoth tusks, describe nearly a circle. The tusks are hollow for a portion of their length from the base, a cone-like cavity being filled with a fibrous, medullary substance. This portion can be sawed into strips and slabs for combs, piano keys, etc., but is wholly unfit for billiard balls.

For billiard balls the tusks are sawed into "chips," each being a cylinder long enough to form at each end a martingale ring, the center being left for the ball. The chip is driven into a brass chuck on a lathe spindle, and a martingale ring turned off the projecting end and the ball partially formed. Then the hemispherical portion is fitted to a wooden cup-chuck and the process repeated. The turning is wholly hand-tooling, even the spherical form of the balls being assured by the educated eye and the skillful hand, without any mechanical aid whatever.

After the turning is done, the balls are polished first with pumice stone and oil, then with chalk, and lastly with the palm of the hand. The balls used in the "pool" game are colored in bands of yellow, blue, scarlet, crimson, green, etc., the coloring matter being cochineal, carmine, tumeric, indigo, and other dyes. To produce the bands with well defined edges, the ball is placed between two brass cups covering every portion but that intended to receive the dye; it is then dipped in diluted muriatic acid and immersed for a few minutes in the hot dye.

Lathes with centered tool holders for turning billiard balls have been used, and are now used, but professional and expert players prefer the hand-turned balls.

A substitute for ivory has been found by the aid of celluloid. These balls are first formed of paper, compressed to great density, and hollow. This ball then receives a coating of celluloid and is turned and finished. These balls are used by some players, but objections are made to them for reasons that do not appear to be always well founded.

The true standard billiard ball is 2⅜ inches in diameter, but for private tables they are frequently made 2½ inches. This admits of their being turned to the standard size when they are defaced or chipped. The standard size, when injured, is turned down for private use, and these again turned down for the bagatelle board, and lastly these are reduced to balls of an inch, or less, which, with numbers on them, are used in billiard saloons by being thrown from a leathern case, taking the place of the dice box, to determine the position of the players in the pool game.

A Cheap Substitute for Stained Glass, which makes also a very perfect imitation of the original, has lately been devised and patented. It consists of printing upon thin sheets of silk paper with brilliant oil colors various artistic patterns, and pasting or otherwise fastening the paper so prepared upon the glass to be decorated. Common window-glass can in this manner be given all the brilliant effects of costly colored glass. The idea is simple and ingenious, and the effects produced are said to be surprisingly good imitations of genuine stained glass.

Improved Packing and Valves.

Recognizing the importance to steam users of any substantial improvements in the manufacture of packing, we present in the following a brief description of an article of this kind for which special merits are claimed by the makers.

The inability of packing, having for its base cotton, leather, rubber, etc., treated with such substances as white and red lead, cements, and the like, to withstand for any length of time the destructive action of heat, pressure, and the acid compounds developed from the oils used for lubrication, originated the idea of the present packing. This may be briefly described as

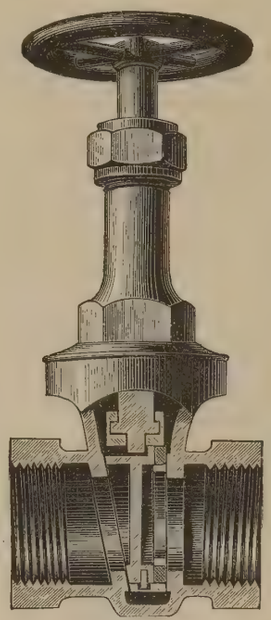


Fig. 1.—"Gate" Valve.

being made of rubber combined with talc, graphite and other refractory substances, forming a composition, which, while it is easily manipulated, is asserted to become so changed under the influence of heat and pressure that it well-nigh acquires the hardness of the contiguous metal. The makers make the claim for this

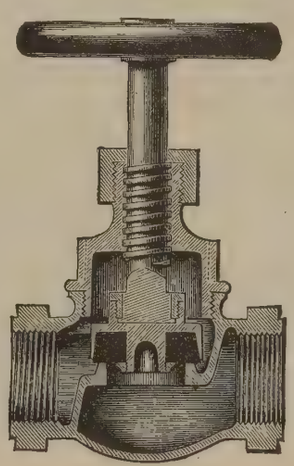


Fig. 2.—Globe Valve.

product, that ordinary usage fails to rot or wear it out, that it is proof against the action of acids, and that it has successfully withstood a pressure of 450 pounds on a boiler used in testing the instruments of the United States Steam Boiler Commission. In addition to its indestructible qualities, the manufacturers claim that it readily adapts itself to all inequalities, thereby forming a very perfect joint.

If two thicknesses of the packing be placed together and followed by pressure, they become as tight as two single pieces of equal bulk; and, on the other hand, by simply coating it with black lead or pulverized soapstone, the joint may be broken as often as may be desired, without injury to the packing. This packing has been in the market for several years, and has been quite extensively introduced.

The makers likewise manufacture several styles of valves, of which two are shown herewith in sectional view. The "gate" valve, Fig. 1, has a disk of compressible packing, held to its seat by a wedge-shaped follower. It has the meritorious feature that it can be repaired at nominal cost without removal from place, by the substitution of another disk. The manufacturers affirm that it cannot be injured by steam cutting out or perforating the packing, and that as the spindle is independent of the disks, it was never known to wedge in opening or closing. It is adapted either for steam, gas or water. The globe valve, Fig. 2, and the angle and the check valves, made by the same manufacturers, use a disk of packing, so that they require no re-grinding. The makers claim to have devoted much attention to the improvement of these disks, until they succeeded in getting them to meet the requirements of practice to their satisfaction. They specially make the point that the valve, being susceptible of repairing without being disconnected with the pipes, recommends it to owners of large mills and manufacturing establishments, since the cost of disconnecting will often exceed the cost of a new valve.

The pump valves made by the same firm, are claimed to possess superior heat resisting qualities, and to be especially valuable for pumping oils, acids, and other destructive liquids, where ordinary rubber valves have proved useless.

The manufacturers of these goods are Jenkins Bros., of 104 Sudbury street, Boston, Mass., who may be addressed for further information.

Zincography for Amateurs.

In a recent paper read before the London Society of Arts, Mr. Thomas Bolas, F.C.S., described zincography as a simple and easy mode of printing, in the following manner: Zincography, he said, is similar to lithography, except that a zinc plate is employed in the place of the lithographic stone. The so-called transfer paper is merely a moderately fine paper which has been brushed over on one side with a mucilaginous mixture prepared by boiling together 1,000 parts of water, 100 of starch, 6 of gamboge, and 1 of glue. This paper is written upon with the ordinary commercial lithographic writing-ink, which has been rubbed up with water like an artist's water-color. The writing being dry, it is necessary to moisten somewhat the back of the transfer by means of a damp sponge, after which it is laid face downward on a sheet of ordinary roofing zinc, which has been previously cleaned by means of emery-cloth. Both being now passed together under the roller of a small press, the transfer adheres to the metal plate; but on dampening the back of the paper it becomes easily removable, leaving the writing on the zinc. The face of the zinc plate is now gently rubbed over with mucilage of gum arabic, which is all the better for being slightly sour, and the excess of gum having been sponged off, an India rubber inking roller, charged with ordinary printer's ink, is passed over the still damp zinc plate a few times. The ink takes only on the lines of the transferred writing, and it is now merely necessary to lay a sheet of white paper on the plate and to pass both through the press to obtain an impression—an exact reproduction of the original writing.

Any number of copies can be printed by repeating the operations of dampening and inking. The zincographic process, thus simplified, is rapid, economical and within the reach of every one.

Mechanical Plastering of Walls.—A machine for plastering walls has been invented, which consists of a receptacle for the mortar—the segment of a cylinder in form. It is provided with a hinged plate that presses against the mortar, and, as the receptacle is moved upward against the wall, forces the plaster out through a narrow opening at the bottom.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$60 00 *a* — —
Pine, good	50 00 *a* 55 00
Pine, shipping box	18 00 *a* 22 00
Pine, common box	17 00 *a* 18 00
Pine, common box, ⅝	15 00 *a* 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	40 *a* — —
Pine, tally plank, 1¼, 2d quality	35 *a* 38
Pine, tally plank, 1¼, culls	28 *a* 30
Pine, tally boards, dressed, good	28 *a* 30
Pine, tally boards, dressed, common	22 *a* 25
Pine, tally boards, culls, dressed	22 *a* 25
Pine, strip boards, merchantable	16 *a* 18
Pine, strip boards, clear	22 *a* 25
Pine, strip plank, dressed, clear	33 *a* 35
Spruce boards, dressed	20 *a* 22
Spruce plank, 1¼-inch, dressed	25 *a* 28
Spruce plank, 2-inch	40 *a* — —
Spruce wall strips	13 *a* — 15
Spruce timber, per M	18 00 *a* 22 00
Hemlock boards, per M	15 00 *a* 16 00
Hemlock joist, 2½x4, each	15 *a* — 16
Hemlock joist, 3x4	16 *a* — 18
Hemlock joist, 4x6	40 *a* — 44
Ash, good, per M	40 00 *a* 45 00
Oak	50 00 *a* 85 00
Maple culls	25 00 *a* 30 00
Maple good	45 00 *a* 75 00
Chestnut	45 00 *a* 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 *a* 40 00
Black walnut, good to choice	85 00 *a* 100 00
Black walnut, ⅝-inch	75 00 *a* 85 00
Black walnut, selected and seasoned	110 00 *a* 150 00
Black walnut counters, per ft	12½ *a* 20
Cherry, wide, per M	85 00 *a* 100 00
Cherry, ordinary	60 00 *a* 80 00
White wood, inch	45 00 *a* 55 00
White wood, ⅝-inch	30 00 *a* 45 00
White wood, ⅝ panels	35 00 *a* 45 00
Shingles, extra sawed pine, 18-inch	4 00 *a* 5 00
Shingles, clear sawed pine, 16-inch	3 75 *a* 4 00
Shingles, cypress, 24x6	18 00 *a* 21 00
Shingles, cypress, 20x6	10 00 *a* 12 00
Lath, Cargo rate	1 75 *a* — —
Yellow dressed pine flooring	25 00 *a* 30 00
Yellow pine girders	30 00 *a* 40 00
Locust posts, 8 feet, per inch	18 *a* 20
Locust posts, 10 feet	24 *a* 25
Locust posts, 12 feet	29 *a* 34
Chestnut posts, per ft	3 *a* 3½
Basswood per M	25 00 *a* 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	5 75 *a*	6 25
Up Rivers	8 25 *a*	— —
Jersey	— — *a*	— —
Long Island	— — *a*	— —
Haverstraw Bay	8 25 *a*	8 50
" choice	8 75 *a*	9 00
Favorite Brands	— — *a*	— —
Hollow Fire-Clay Brick	9 00 *a*	9 25

FRONTS.

Croton—Brown, per M.	11 00 *a* — —
" Dark	12 00 *a* 13 00
" Red	12 00 *a* 13 00
Philadelphia	— — *a* — —
Trenton	— — *a* — —
Baltimore	— — *a* — —
Clark's Ottawa White	25 00 *a* — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	32 00 *a* 33 00
" Glengarnock	29 00 *a* 30 00
" Eglinton	28 00 *a* 29 00
" American, No. 1	38 00 *a* 39 00
" American, No. 2	37 00 *a* 37 50
" American, forge	35 50 *a* 36 50

	Store prices.	Cash.
Bar, Swedes, ordinary sizes	— 6 *a*	— 6¼
Bar, Swedes, nail-rod	— 6½ *a*	— —

LEAD—PER 100 POUNDS.

*German	— — *a* — —
*English, common	— — *a* — —
*Spanish	— — *a* — —
*Foreign, refined	— — *a* — —
*Bar	7 00 *a* — —
*Sheet	8 00 *a* — —
*Pipe	7 50 *a* — —
*Domestic	5 50 *a* 5 63½

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 70 *a* — —
8d and 9d, common	3 95 *a* — —
6d and 7d, common	4 20 *a* — —
4d and 5d, common	4 45 *a* — —
3d and 4d, light	5 20 *a* — —
3d, fine	5 95 *a* — —
2d, fine	5 95 *a* — —
Cut spikes, all sizes	4 95 *a* — —
Finish nails, 1½ to 1¾ inch	5 95 *a* 6 20
do. 2 to 2¼ inch	5 70 *a* — —
do. 2½ to 2¾ inch	5 45 *a* — —
do. 3 inch and longer	5 20 *a* — —

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	10 00 *a* 10 25
*I. C. coke, 10x14	8 25 *a* 9 50
*I. X. charcoal, 10x14	12 00 *a* 12 25
*I. C. charcoal, 14x20	10 00 *a* 10 25
*I. X. charcoal, 14x20	12 00 *a* 12 25
*I. C. coke, 14x20	8 25 *a* 9 50
*I. C. coke, terne, 14x20	8 50 *a* 8 75
*I. C. charcoal, terne, 14x20	9 00 *a* 9 50

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 8¾ *a* — 8½
Sheet, (open)	— 9 *a* — 9½

SOLDERS.

No. 1	— 14½ *a* — 15
No. 2	— 13½ *a* — 14

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 *a* 1 00
Berlin Freestone, in rough	— 75 *a* 1 00
Berea Freestone, in rough	— 75 *a* 1 00
Brown-Stone, Portland, Conn	1 30 *a* 1 35
Brown Stone, Belleville, N. J	1 00 *a* 1 35
Granite, rough	— 60 *a* 1 25
Canaan Marble	1 25 *a* 1 50
Dorchester, N.B., Stone, rough, per foot	— — *a* 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 *a* 7 25
Chalk, per 100 lbs	— 55 *a* — —
China Clay, per ton gold	18 00 *a* 20 00
Chrome yellow, dry, per pound	— 12½ *a* — 28
Lead, red American, per pound	— 8 *a* — 9
Lead, white American, pure, in oil	— 9 *a* — 9½
Lead, white American, pure, dry	— 8¾ *a* — 8¾
Lead, white English, pure, in oil gold	— 9½ *a* — 10½
Litharge	— 7½ *a* — 8
*Ochre, Fr., dry, per 100 lbs	1 50 *a* — —
Ochre, ground, in oil, per lb	— 6 *a* — 15
Ochre, Vermont, per 100 lbs	— 75 *a* 1 00
*Orange Mineral, English gold	— 9½ *a* — 10
Paris White, American	— 1½ *a* — 1¾
Paris White, English, prime	— 2 *a* — 2¼
Paris Green	— 15 *a* — 28
Plumbago paint, patent, per lb	— — *a* — 25
Putty, per lb	— 2½ *a* — 3
Spanish Brown, dry, per lb	— 1⅝ *a* — 1¾
Spanish Brown, ground in oil, per lb	— 8 *a* — 9
Venetian red, per cwt	1 75 *a* 2 00
*Vermilion, Chinese, per lb	— 85 *a* — 90
*Vermilion, Trieste	— 70 *a* — 75
*Vermilion, quicksilver, bags gold	— 60 *a* — 62½
Vermilion, American, common	— 15 *a* — 18
Whiting, per 100 lbs	— 60 *a* — 80
Zinc, white American, dry, No. 1	— 5 *a* — 7½
Zinc, white American, No. 1, in oil	— 8 *a* — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¾ *a* — 9
Zinc, white French, in oil gold	— 10 *a* — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 *a* 4 00
Coach Body	2 35 *a* 3 50
do do	1 80 *a* 2 00
Furniture	1 25 *a* 2 50
Black Asphaltum	1 00 *a* 1 50
Brown Japan	1 00 *a* 1 20
Liquid Paint Dryer	1 35 *a* 1 75
Harness, (black)	3 00 *a* 4 50
Shellac, Spirits	3 00 *a* 3 50

CEMENT—PER BARREL.

Portland (imported)	2 85 *a* 3 25
Portland (American)	2 65 *a* 3 00
Portland (Spanish)	2 50 *a* 2 75
Portland (Lafarge)	3 20 *a* 3 40
Portland (German, Bonner)	2 85 *a* 3 25
Lime of Teil	2 20 *a* 2 30
Lime of Teil, per ton	15 00 *a* 18 00
Roman	2 75 *a* 3 25
Keene's & Martin's, coarse	6 00 *a* 6 50
" fine	10 50 *a* — —
Rosendale	1 10 *a* — —

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb. — 1¼ *a* — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16 *a* — 18
Goat, " "	— 21 *a* — 25

SLATE.

Purple roofing slate, per square	$6 00 *a* 7 00
Green slate	7 00 *a* 7 50
Red slate	10 50 *a* 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 *a* 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 *a* — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	— — *a* — —
Nova Scotia, blue	— — *a* — —
Calcined, Eastern and city, per bbl	1 25 *a* 1 40
Calcined, city casting	1 45 *a* 1 50
Calcined, city superfine	1 55 *a* 1 75

LIME—PER BARREL.

State, common	— 90 *a* — 95
" finishing	1 10 *a* — —
Rockland, common, cargo rate	1 00 *a* — —
" finishing	1 25 *a* — —
Ground	1 60 *a* — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 20 *a* — 35
St. Domingo, crotches, fine	— 25 *a* — 50
St. Domingo, logs, small	— 5 *a* — 8
St. Domingo, logs, large	— 20 *a* — 30
Frontera, Mexican, large	— 11½ *a* — 16
Frontera, Mexican, small	— 8 *a* — 10
Other Mexican	— 8 *a* — 14
Honduras	— 10 *a* — 15

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ *a* — 6
Rio Janeiro, good to fine	— 5 *a* — 8
Bahia, ordinary to good	— 2 *a* — 6½
Bahia, good to fine	— 4½ *a* — 8
Honduras, per ton	10 00 *a* 20 00
Satin Wood, per foot	— 15 *a* — 60
Tulipwood, per lb	— 6 *a* — 12½
Lignumvitæ, small, per ton	25 00 *a* 65 00
Lignumvitæ, large	25 00 *a* 50 00

CEDAR.

Cuba, per superficial foot	— 10 *a* — 12½
Mexican, small	— 8 *a* — 10
Mexican, large	— 10 *a* — 14
Florida	— 30 *a* 1 50

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¾ inch.	$ 84 —
2.6 x 6.6	1¾	1 18 —
2.6 x 6.8	1¾	1 24 —
2.8 x 6.8	1¾	1 30 —

DOORS, MOLDED.

Size.	1¼ inches.	1½ inches.	1¾ inches.
2.0 x 6.0	$1 54	—	—
2.6 x 6.6	1 90	2 41	—
2.6 x 6.8	1 96	2 43	—
2.6 x 6.10	1 98	2 51	—
2.6 x 7.0	2 02	2 61	—
2.8 x 6.8	2 02	2 61	3 20
2.8 x 7.0	2 11	2 71	3 36
2.10 x 6.10	2 23	2 82	3 55
3.0 x 7.0	2 33	3 06	3 75

WINDOW FRAMES.

Up to 3.4 x 7.2, put together | $2 30 *a* — —

GENERAL REVIEW OF THE MARKETS.—The markets have undergone a steady improvement during the past month, and prices on most grades of goods have been remarkably well sustained. The bulk of business has been large and of the most satisfactory character. The tone of the building market, as indicated in our "Building Intelligence" department, is certainly very encouraging and gives indication of a large volume of business during the season.

THE MARKETS IN DETAIL.—In the brick market business has been good. The supply has been somewhat irregular, at times running full and again comparatively light, but generally running a little over the actual requirements of the current demand which, on the whole, has been quite slow. The very open winter has admitted of such steady building operations that there is now less than the usual amount of unfinished work for this season, and as contractors are hardly ready to commence on new jobs the consumption is reduced.

The lumber market has shown no great degree of animation owing to the rather careful manner in which all classes of operators are moving, yet trade has been good for the season, and the demand really better than the business accomplished.

In the lime market the situation of affairs has remained about the same with demand a little slow, and, on the whole, somewhat disappointing. Prices are about the same as last quoted.

In the cement market business has been fair, but the position of the market has changed somewhat by the fixing of a wholesale rate for the season. The figures, decided upon by the manufacturers of Rosendale, are $1 at the "Creek" and $1.10 here, and only small jobbing parcels from dealers' hands exceed these figures. On the imported brands the feeling has been strong and the demand good, with more stock wanted.

In the market for hair demand has shown full proportions with the movement still good and promising.

In the lath market there has been some irregularity since our last, cost at first shrinking from $2 or a fraction under, followed by a better feeling, with holders showing much firmness at the above rate, and succeeding in making a few sales for a time and exciting a little anxiety among some of the dealers.

In the hardware market demand has been without much animation, but values have had a steady tone and a good spring business is looked for.

In the metal markets American pig has been weak and unsettled, while Scotch pig has been dull and the market heavy under the light demand, and accumulating stocks here as well as the downward tone of the foreign market. Manufactured iron has become very unsettled, and there has been really no fixed market value. Domestic pig lead has broken down in price under more liberal offerings of both domestic and foreign and the market has shown a feverish uncertain tone with sellers still more anxious to do business than buyers. Pig tin has been held with an effort at steadiness in some cases, but the limited uncertain demand and supplies cropping out from unexpected sources have had a weakening influence, and the general tendency has been in buyers favor. Tin plates have favored the buyer throughout without creating much new demand, and the market has been flat and unsatisfactory on all grades.

In the paint market in a wholesale way trade has been rather dull, but a good business is anticipated for the present month.

Home Industry as a Corrective of Labor Strikes.

The spectacle of idle workmen and unemployed artisans reappears most unexpectedly just as the dawn of prosperity has begun to open after our seven years of industrial famine. It is disheartening. We had good reason to suppose that the lessons of the past were better learned. Strikes against lessened wages had seldom prevented the decline, for the causes of decline were beyond the control of capital, and capital was itself being extinguished by them. There is no good reason for believing that strikes at this time will produce any greater rise of wages than would result naturally, and without them, from the increased demand for products and the accompanying increased demand for workmen. It were well if labor associations were instructed in the doctrine of averages. The per diem of wages that workmen obtain is necessarily the average of all their idle and all their working days together. While idle, they must be supported, either by the cash of their friends who still work on, or by the credit accorded by their fellow workmen with whom they deal. But it is an inevitable law that credit must be paid for by higher retail prices; hence the wages of to-morrow must pay for the credits of yesterday; and so wages, even if nominally higher, have no greater purchasing power than the lower wages against which the strike was made. The effects of demand for higher rates of work extend over a very wide space—over the whole country, indeed. With it goes a higher price for every article that is sold at retail, and so again the doctrine of averages reaches the "striking" workman, as well as every other consumer, for while demanding the 10 or more per cent advance for wages, his family must pay the like advance upon every pound of sugar and coffee, upon his loaf of bread, his quart of milk, and upon every article that he consumes. In time the balance is struck and prices become equal, but always with the result that no gain has been procured by the strike.

The workingman's interests are best consulted when wages are fixed and work steadily afforded him. How to bring this about—how to make work steady and wages fixed, while the ratio of supply and demand is ever changing, is *the* question that must concern us today. Probably no one is equal to its solution. The conditions change as rapidly and as completely as do the reflections of the kaleidescope; but as the kaleidescope is not without its laws, although the special law of each turn escapes our timely recognition, so the changes between labor and wages, consumption and production, coin and credit, which so elude us, have their laws also, and in part we may detect them.

One of the conditions of disturbance is undoubtedly the immense over-production of a few persons by means of steam power—factory labor. The ability of 80 per cent of the population to consume the products of labor depends upon being themselves producers. They are not capitalists; neither are they receivers of incomes from invested capital. In order to buy the products of steam labor, they must themselves be receivers of wages in some form, or else they must produce by their individual labor something that steam power does not control. It is the problem of the day to find that "something," and to induce the non-consuming public to engage in its production. That "something" must be a work performed at "home" by the domestic fireside, amidst the comforts and quietude of the family circle; it must occupy the otherwise unemployed hours of such members as are not steadily engaged at wage-work which consumes their whole time. The idea is well illustrated by reference to the knitting-needle and the many articles of wearing apparel (gloves, caps, shirts, stockings, jackets, and even trousers) that were formerly made of a coarse and homely sort, by the good woman of the house and her older daughters. Sometimes a sick or disabled son, or an infirm, invalid husband, or a dependent male relative, would while away the tedious hours in work, which produced little if compared with factory work, but aggregating enough to be an important help to the family larder, and in the great aggregate of all families made an immense addition to the gross products of the country, for it was not knitting alone, but many other small domestic industries that were formerly pursued in the same silent manner. Steam power has transferred all these to the factory. Its product greatly exceeds the demand, for the power to consume has been taken from the family, together with the family work, and it is not restored by the wages gained at factory work.

These remarks apply perhaps more to the country families than to the dwellers in cities and towns. It has been shown by the census returns that a steady flow of population from country farms to small towns and to the cities has been going on for thirty years past; and its alleged cause is that country folk may win from the factory the income that can no longer be derived from their individual home work. The problem therefore is, to find a hand work which cannot be done by steam power, and whose product will be salable notwithstanding the large productions by steam. We find this at the present time only in the raising of silk. It is in a true sense a manufacture, since its processes are all really by hand, and they can be but little helped by machinery of any sort. The raising of the silk-worm belongs to agriculture; it is of necessity a family work; it belongs to the country family; it is in the small tenements of the peasantry in silk-growing countries that the cocoons are raised, where the leaves are at hand and the children numerous and the time not completely occupied with steady work. The reeling may be done at the factory in part, and so be also a city or village work; but in the silk districts it is more common to find the family reel it and to see the mother and daughters engaged in running off the threads from cocoons that they themselves have raised. It becomes a hereditary employment; skill descends from mother to daughter; the child, seeing it done from early infancy, and putting her own hands to the work while the fingers are pliable and the muscles easily trained, acquires a skill that seems almost marvelous. She is able to turn out her pound of silk per day and to make the highest wages from it.

These home-made wages, or income derived immediately from individual home work, is probably the only true corrective for this disturbance of all values by combinations of capital on the one hand or of labor on the other. The aggregate of production, and the constant production, of an article of such ready sale as silk, and the steadiness of a work that can be laid down or resumed at will, ought to be, and we think would be, a balance-wheel for the unsteady motions of trade, whose shattering effects upon all fortunes we deplore. At any rate, the suggestion is here thrown out and is worthy of consideration whether the renewal in some shape of those old-time home industries will not prove a corrective of labor strikes in two ways; first, it will increase the purchasing power of that half of the population who live outside of the towns and cities, and so will maintain steadiness of demand for all productions that the home circle does not produce; second, it will be a resource for workmen when wages are reduced below what they consider a living rate—they will turn their hands to home work until higher wages attract them again to the factory.

While silk-raising is not the only work that will have this tendency, it is yet the most available at this time, because the supply is known to be deficient, and to be decreasing, while the demand is steadily on the increase, especially in the United States. Other industries may in time be added to this with the same purpose and to the like effect; but it is important to remember that the little home industries produce in the aggregate the real wealth of the country, and that the circulation of money in the rural districts keeps up the flow in the great rivers of trade.

Samuel Chamberlaine, M. D.

Philadelphia, March, 1880.

Rule for Finding the Heating Surface of Vertical Tubular Boilers.—Multiply the circumference of the fire-box in inches by its hight above the grate in inches; multiply the combined circumference of all the tubes in inches by their length in inches, and to the sum of these two products add the area of the lower tube or crown sheet. Divide by 144, and from the quotient subtract the combined area of all the tubes, and the fire door. The remainder will be the number of square feet of heating surface.

Malleable Glass.

The curious anecdote about malleable glass which has been told by Pliny and by Petronius Arbiter, should not be passed over without mention, whatever importance we may think proper to attach to it.

The story, as given by Trimalchio at his banquet, runs as follows: "There was once an artist who made glass vessels of such firmness that you could no more break them than gold or silver. This person, having made a cup of the finest crystal, and such a one as he thought worthy of none but Cæsar, got admission to him with his present. The beauty of the gift and the skill of the workman were highly commended, and the zeal of the donor kindly received. When the man, that he might change the admiration of the court into astonishment and ingratiate himself still more in the favor of the emperor, begged the cup out of Cæsar's hand and dashed it against the pavement with such vehemence that the most solid and constant metal could not escape unhurt. Cæsar was both surprised and troubled at the action; but the other, snatching the cup from the ground, where it lay unbroken, and only a little bulged, as if the substance of metal had assumed the likeness of glass, drew a hammer out of his bosom and very dexterously beat out the bruise, as if he had been hammering a brass kettle. And now the fellow was wrapt in the third heaven, having, as he imagined, secured the friendship of Cæsar and the admiration of all the world. But it happened quite contrary to his expectation, for Cæsar, asking him if any one knew how to make glass malleable besides himself, and he answering in the negative, the emperor commanded his head to be stricken off; for, said he, if this art be once propagated, gold and silver will be of no more value than dirt."

Pliny tells substantially the same story, naming Tiberius as the emperor; but says that the artist's workshop and tools were destroyed, not that he was put to death. It is probable that these tales originated from an exaggerated report of a discovery of a process by which the brittleness of glass was much diminished, as in the annealing of this substance in oil, a method that has lately excited a good deal of attention.

Corrosion of Iron by Fats and Oils.

Some recent experiments made in relation to this subject have shown very conclusively that even perfectly neutralized fatty oils have a strongly corrosive action on iron in the presence of steam. In one experiment, a bucket of iron turnings, steeped in colza oil that had previously been neutralized (presumably with carbonate of soda), was exposed for eight days to the action of high pressure steam, in a closed reservoir provided for the purpose. At the end of that period the turnings were found to be strongly corroded, and the bucket contained about a pint of a viscid brownish oil, having a strongly acid smell. It oxidized readily in the air, depositing peroxide of iron; and after purification by solution in ether and distillation of the solvent, it was found to rapidly saturate itself with iron when again placed in contact with it. In another experiment, a flask was provided containing iron filings previously steeped in completely neutralized colza oil, as before. Into this steam, at atmosphere pressure, was led. From this apparatus hydrogen gas was continuously disengaged, showing that even at the temperature of 212° Fah., fatty matters, carefully neutralized and containing no free acid, are capable of decomposing steam in the presence of iron.

Home Department.

House Drainage.

From the latest of the *American Health Primers*, entitled "Our Homes," which has just appeared from the pen of Dr. Henry Hartshorne, we observe some excellent and practical hints on house drainage, which we reproduce in what follows, by the kind permission of

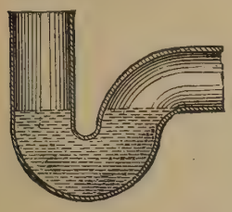


Fig. 1.

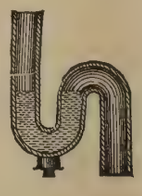


Fig. 2.

the publisher, Presley Blakiston, of Philadelphia, to whom we are also indebted for the illustrations.

"Ours," says a late writer on house construction, "is the Age of Plumbing." Egyptian, Greek, and Mediæval architectures have, each in succession, had their day, and now the beautiful gives way, in a large degree, to the useful. Stramm, a German author, declares that the highest modern civilization is shown not so much by costly monuments and works of art as by the perfection of house conveniences. Yet these, too, have their dangers as well as their comforts. Security does not always come with refinement. Ferocious beasts and venomous serpents are kept at a distance in the wilderness, but the subtle poison of disease

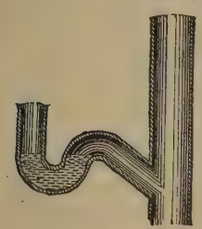


Fig. 3.

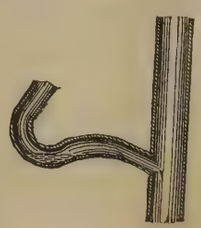


Fig. 4.

may steal upon us in our beds, and, vampire-like, draw out the life from our veins. When the Prince of Wales, some years ago, fell ill with typhoid fever after a visit at Londesborough House, all the world was alarmed. It is probable, however, that the inquiry which this event and its supposed cause started, may have resulted in saving many lives.

When a house is being built for occupation in a chosen situation, its light, warmth, ventilation and water-supply having all been provided for, there remains the question of conservancy—that is, the safe and sufficient removal of all waste. In the country simple measures will answer, so far as health is con-

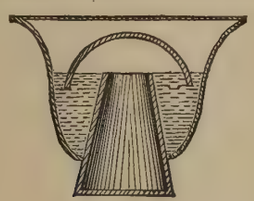


Fig. 5.

cerned. On an acre of ground there is space enough to place a privy at a good distance both from the house and from the drinking-well. If there be any slope, the last-named must be always above the first, and thirty feet at least (the more the better) must intervene between the two wells. Kitchen slops should have their own separate drainage, or, at least, should run through a channel, open for a short distance, before they enter the privy well.

But it is a question, with a cottage or small farm-house, whether a well for necessary waste is best. The farther from the house it is possible to place it, the less need there is of a well. The common cottage privy above ground, the building being raised and open (below) at the rear for frequent removal, needs only a simple precaution to make it innocent. This safeguard is, to throw over the deposit each time a small shovelful of lime or dry earth. The latter is, of course, the more accessible, and will deodorize and disinfect perfectly if

Fig. 6.

enough be used. A pint and a half in bulk, or two and a half pounds in weight, will suffice each time. A box of earth and a trowel may be left within reach. Frequent removal is then important. Where there is a vegetable garden, the material thus accumulated makes the best possible manure; this has been proved not only in China, but in Europe and in this country

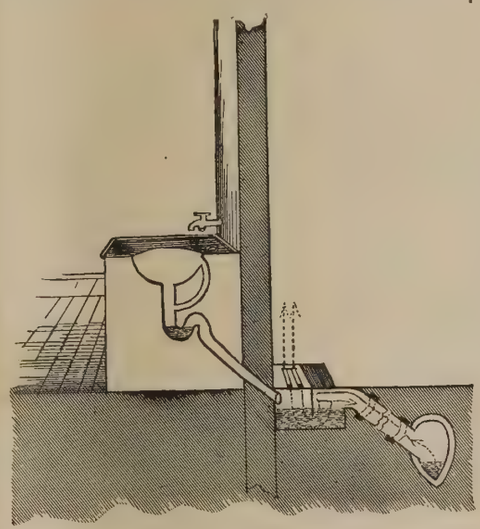


Fig. 9.

also. With a small family, however, when dry earth is used, once in three or four weeks will commonly answer for its removal.

There are two sides to the question of advantage to health in regard to the distance of a privy from a country house. Delicate persons run risks in the exposure of going out of doors in cold or rainy weather. A covered passage-way, with windows, or otherwise open at the sides for ventilation, lessens but does not entirely obviate this evil. For those who cannot or ought not to leave the house, a convenience is needed. Much evidence favors the earth-closet as here the best resort. There are different patterns of this, but the idea in all is the same. By a mechanical contrivance, each time that the closet is used, a suitable amount of dry earth or sifted ashes is thrown down from a receptacle in which it has been placed. Those who cannot afford to buy an earth closet, can substitute it by keeping within reach a small box supplied with earth and a trowel for its use. The disadvantage of this is the flying of dust into the room, which indeed the best contrived closets do not always entirely prevent. Especially with the addition of a very little chloride of lime in powder to the earth when used, or even without this, an earth-closet is much more satisfactory than the old-fashioned chair in the sick room, or elsewhere in the house, for the avoidance of everything unpleasant.

Earth for this purpose must contain some (but not too much) clay and some *humus*, or soil such as is fitted for cultivation. Common garden earth, or that of the average farm ground, will do very well. Sand will not answer; sifted coal-ashes will, almost as well as earth. On a small scale, earth may be dried in any convenient receptacle over or near the kitchen fire.

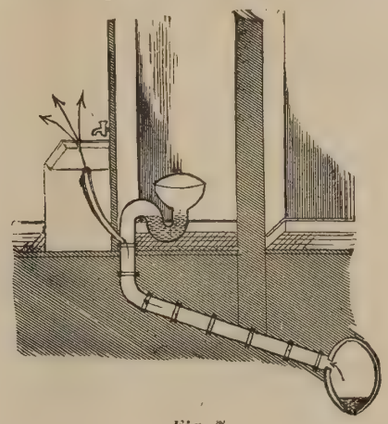


Fig. 7.

For a large family, a quantity of earth may be placed to dry gradually under a shed, with boards under it to keep it from the dampness of the ground

The earth-closet system has been introduced into several towns in Europe with success; but the requirement of bringing a great weight of earth into a city, and economically disposing of it after use, will make it slow to take the place of the water system in cities. Household employment of the latter system, therefore, must next receive our attention.

Every kitchen should have its drain, as it is against all laws of health, as well as of appearance and comfort, to throw slops out of doors on the ground. Garbage in cities is, or ought to be, removed daily in covered carts from all houses. In the country, a good plan is to dry hard materials (potato skins, etc.) under the kitchen fire, and then burn them upon it. Otherwise such things may be given to hogs, or dried at a distance from the house and burned. Dust swept from floors may be thrown into the fire. Liquids from the kitchen should not be poured upon the ground near a well, or they will run or soak down into it and spoil the water. Sometimes a foul kitchen drain taints a drinking-well for a long time without suspicion, doing very serious harm. Sanitarians aver that kitchen drainage may become almost as bad as sewage from house and street waste. Every kitchen drain, therefore should have a trap. Since this is true also of every water closet, we may now at once consider what traps are, and their use. They are intended to prevent foul air from getting back to a house from sewage or drainage after the latter has been discharged.

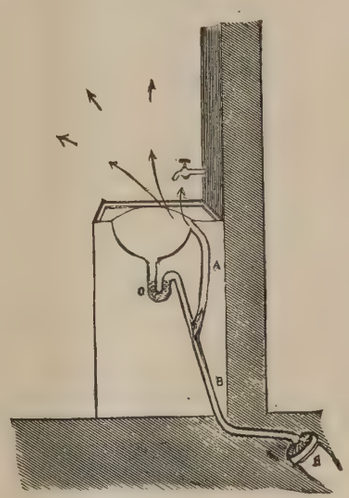


Fig. 8.

A water-seal is afforded, as shown in Figs. 1 and 2, by the portion of water detained after a quantity has passed through the pipe. The conditions necessary for the security of every trap, are: that it be large enough;

the "drown" or dip of water above the upper line of depression at the middle, sufficient; that this dip be not lost by distortion of the pipe (see Fig. 3 correct, and Fig. 4 distorted); that it be of material thick enough not to be soon corroded and perforated by sewer air or water; that it be not clogged by solid and insoluble things thrown into it; that it be furnished with an abundance of water for "flushing," or cleaning it out frequently; that it be ventilated; and that, when not used, it be not allowed to become dry from evaporation. All these conditions are frequently violated or neglected, and hence some people have come to regard all traps as entitled to their name in a contrary sense, as snares or delusions. But when properly made and used, they are very serviceable; and whatever farther advance sanitary science and invention may hereafter furnish, we cannot, so long as we employ the "water system," do without them now.

Cast lead traps are generally used, of good weight—7 or 8 pounds of lead for each square foot of surface. A trap for a soil pipe 4 inches in diameter should have the same diameter, and should weigh 20 pounds. The "drown" or depth of water above the upper bend should be, for such a trap, at least 1½ inches. To prevent swagging down out of shape, every pipe, through its whole length, trap and all, must be securely fastened and supported. Nothing should ever be thrown into a water-closet or sink which cannot be soon softened and dissolved away, so as not to produce obstruction. Every trap should have its own water-cistern, distinct from any cistern supplying drinking water; and the flow through it when used should be free and abundant. Its overflow-pipe should discharge apart from any sewage drain. The time when evaporation is likely to dry up traps, so as to permit the entrance of air from the drain or sewer below, is when families are absent from their homes, as during the summer season, or when a house is for any reason unoccupied for weeks or months together.

Bell traps (see Fig. 5), according to the best authorities, ought never to be used, on account of their clogging more easily than other traps, and always allowing only a sluggish flow through them. Since all traps necessarily delay the movement of the contents of pipes, and stagnation makes everything worse, it may be asked, Why is it not better to avoid all such interruptions, and merely provide such abundant flushing as will sweep all impurity rapidly away? The answer is, that if such thorough and constant flushing were secure in the whole length of every drain and sewer of a connected system, no traps would be needful. As such thoroughness is not usually, if anywhere obtainable, "water seals" limit to great advantage the amount of exposure of the air above them to contamination.

It has been proved by experiment that sewer gas is absorbed by the water of a trap if it remains long there at rest, and then the gas is given out above and beyond the water seal. Therefore, frequent changing of the water is indispensable, and also measures for making sewer air itself as innocuous as possible.

Of reservoirs and pipes for water supply, it needs only to be repeated here that the same tank or cistern ought never to be used to furnish water both for drinking and for water-closet use. Moreover, the overflow pipe of a drinking tank or cistern must be carefully kept clear of the soil pipe drain and sewer. It is best for such overflow, as well as that from every lavatory or wash-basin, to discharge by itself. Kitchen drainage is subject to greater foulness than water from drinking hydrants, lavatories, or baths. In a perfect system, it must be kept apart from them in its conduction and discharge. It ought much more urgently to be separated from the water-closet drainage. This last needs, for really good sanitation, to be entirely apart from all the other drainage of the house.

If the overflow pipe under a drinking hydrant, lavatory, or bath-tub must, in any case, discharge into a drain which receives also the kitchen slops, or worse, the contents of the soil pipe from water-closets, a trap must be interposed to prevent the ascent of foul air into the apartments concerned. For lavatories, the trap shown in Fig. 6 has been found to answer well; best when it is all made of zinc or lead, instead of partly glass; B represents a floating ball of rubber, which, being buoyed up by the water in the trap, makes a doubly efficient seal against the ascent of impure air to the lavatory from the drain below.

Every bath waste pipe, when it connects with a soil pipe, house drain, or sewer, should have a trap—such, for example, as is shown in Fig. 1 or Fig. 2. So also should every kitchen sink, and slop sink of any kind, have the same protection; otherwise there is opportunity for bad air to rise through those pipes, and to contaminate the air, food and water in the kitchen or elsewhere through the house. How this may happen is easily seen by looking at Fig. 7; there the water-closet has been trapped, but not the kitchen sink, and both communicate with a sewer. Not only the sink itself, or lavatory, or both, but in each instance, the overflow also must be protected by the trap. Figs. 8 and 9 exhibit respectively the fault here indicated, and its remedies. These remedies (Fig. 9) are: first, making the overflow pipe enter that of the sink above the trap; and second, having the lavatory escape pipe to discharge over an open channel, instead of connecting directly with a soil pipe or sewer.

This subject will be continued in our next number, in which the question of water-closet and soil-pipe arrangements will be discussed.

Effects of Turpentine on the Health.—A French physician who has studied the effects of turpentine on some 300 painters coming under his observation, arrives at the conclusion that the injurious effects produced by turpentine fumes can never be sufficiently severe to cause death, unless they be volatilized in an extremely confined space—that, where there are free movement of the air and good ventilation, there need be no fear whatever of fatal accidents from this cause. He has noticed that the vapors of the turpentine coming from different sources have not at all the same energy; that of the French product, for instance, being far less injurious than those of Hungarian or American turpentines. Again such evil effects as are produced are, he says, mostly in the cases of workmen unused to the trade; a very short time, however, sufficing to habituate them thoroughly to its effects. The most general form of indisposition met with among them, which may be directly attributed to the turpentine, are headache, watering of the eyes, coryza, cough, granulations on the larynx and disordered digestion.

Miscellaneous and Advertising.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

The manufacturers of the Cameron steam pumps, ever progressive, are making continual improvements in their productions, maintaining the standard of excellence which this house has always been noted for both at home and abroad.

Special attention is called to the perforated iron, brass, copper and zinc plates which the Lidgerwood Manufacturing Co., of 96 Liberty street, this city, are making for all purposes. They make the holes either round, square or flat, as ordered.

The Loose Pulley Lubricator Manufacturing Co., of Middletown, Conn., manufacture an excellent lubricator, which they claim is the only reliable automatic loose pulley oiler in the world. Manufacturers would do well to send to this company for one of their illustrated circulars.

Since the iron "boom," manufacturers are finding out the wooden belt pulleys manufactured by the Taper Sleeve Pulley Works, of Erie, Pa., are not only very much lighter, the adhesion of the belt twice as great, the fastening perfect balance, but also that they are cheaper, especially in the larger sizes, than iron pulleys.

An exchange solemnly avers that a certain man in town who never advertised, was recently found dead under his counter, where he had been lying two days. People had forgotten where his store was, and a stranger looking for a storehouse was the discoverer of the deceased proprietor. This is a solemn warning to those who think advertising doesn't pay.

The Hartford Steam Boiler Inspection and Insurance Co., of Hartford, Conn., made, during the month of January of this year, 1,687 inspection visits, and the total number of inspections made was 3,680, of which 1,224 were thorough annual internal inspections. The hydrostatic test was applied in 233 cases, in an auxiliary way mainly, to detect leaks in new and in repaired boilers. The whole number of defects discovered during the month was 1,738, of which 361 were of so serious a character as to be considered dangerous at the moment of discovery, or would have become so by the natural progress of deterioration before the time for the next inspection. This record is a large increase of work done—200 more examinations being made than in December last, and about 9 per cent increase in the number of visits made, notwithstanding that the survey of reports for the last month of 1879 was the largest ever exhibited in this country covering a like period, previous to that time. This indicates a very satisfactory increase in the company's business.

It gives us pleasure to note the fact that Messrs. Babcock & Wilcox have sold nearly 6,000 horse-power of their celebrated water-tube boilers during the month of March just past. This must certainly be extremely gratifying to the manufacturers, as showing the growing appreciation and popularity which their admirable boilers are meeting with among steam-users, and confirms the high opinion that we have maintained for them through the columns of this journal during the past eight years. The position the manufacturers of these boilers occupy has been deservedly earned by the progressive spirit in which they have always conducted their business, adopting improvement after improvement, until the present perfect construction was reached. In building these boilers, every detail is carefully looked after, and nothing but the very best skill and material are employed; the result of this, and the advantages of the water-tube system, are gaining for them a very enviable reputation and displacing those of other makers in many establishments throughout the country.

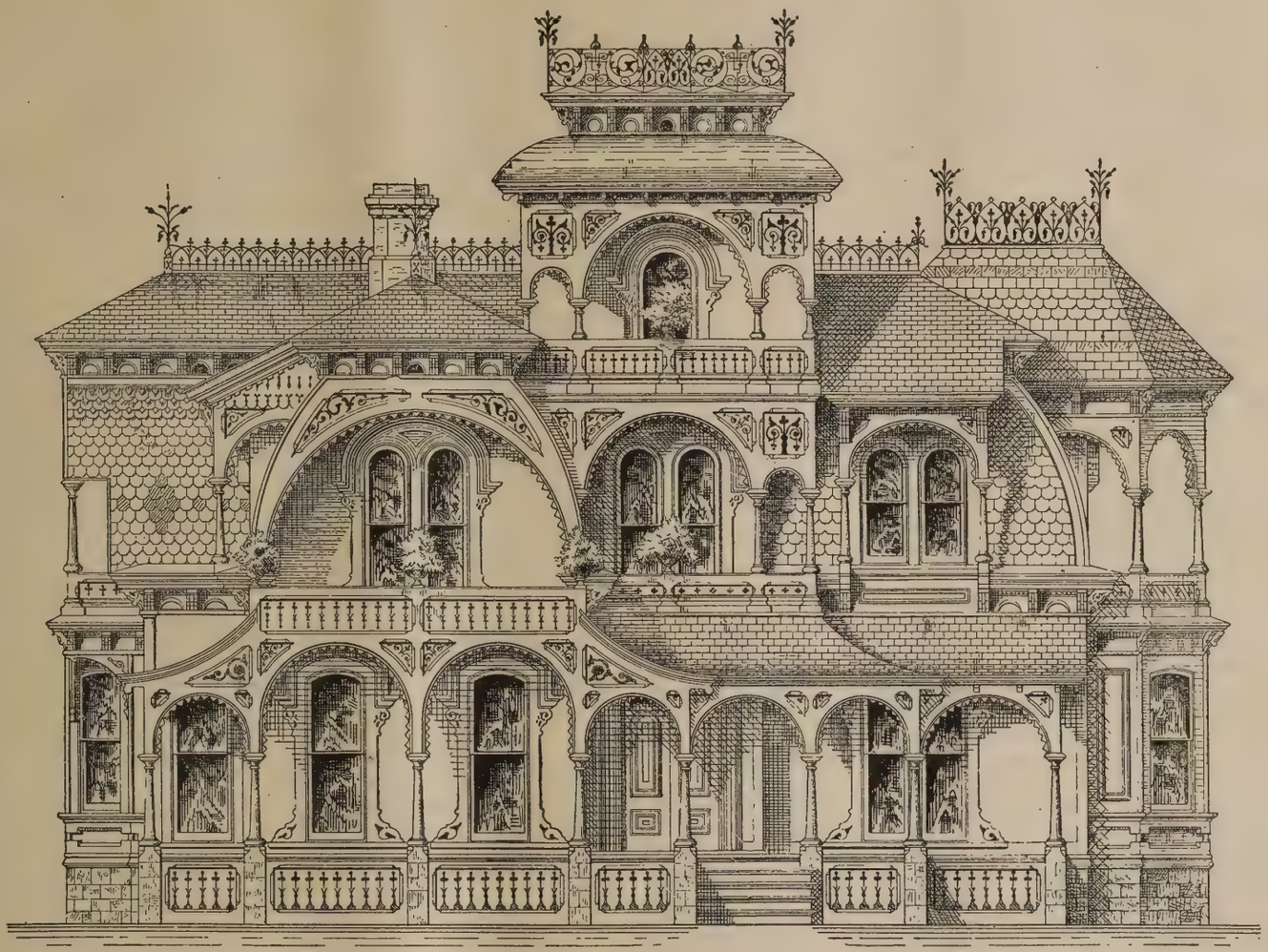
Suburban Residence.

Those of our readers who desire a suburban residence in which picturesqueness, elegance and simplicity of construction are successfully united will find the somewhat unique and beautiful design herewith presented particularly interesting and serviceable. The elevation has been so carefully drawn that a minute description of the exterior finish is rendered unnecessary. The construction, which can only be intelligently presented in the form of full detail drawings, is of such character as will secure the greatest beauty and durability at the least expenditure of labor and material, and by a careful attention to the importance of proper contrast of colors in the painting, the cottage can be made extremely attractive. A more harmonious and effective combination of curved lines, and a more beautiful range of light and shade, could hardly have been produced.

The excellent internal accommodations are explained by the following letters of reference on the floor plans: A, portico; B, veranda; C, main hall; D, library; E, dining room; F, parlor; G, kitchen; H, cellar stairs; I, servants' stairs; J, closet; K, water closet; L, bay window; M, butler's pantry; N, kitchen pantry; O, sink; P, range; Q, boiler; R, porch; S, hall; T, chambers; U, boudoir; V, balconies; W, bath room; X, closets; Y, roofs; Z, alcove.

This house is estimated to cost $4,500.

Any further particulars in regard to it will be cheerfully given by the architect, Mr. Horace G. Knapp, of Nyack, N. Y.



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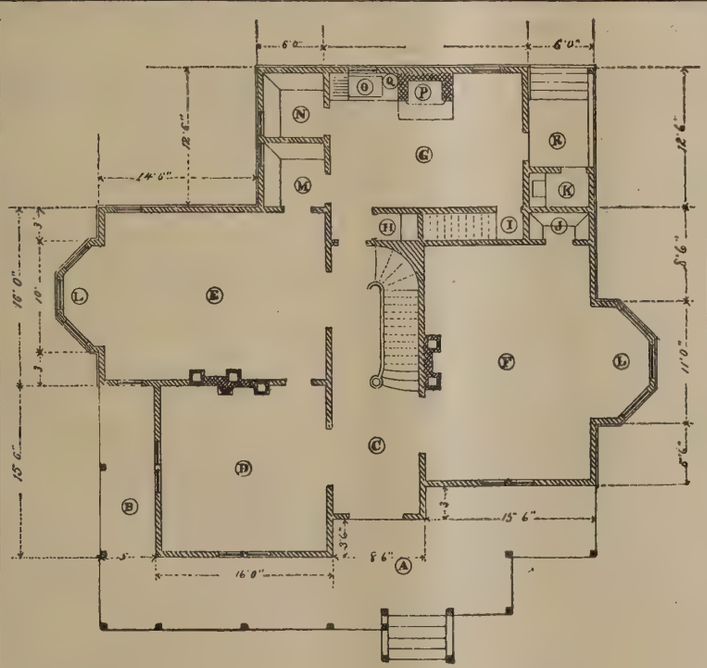
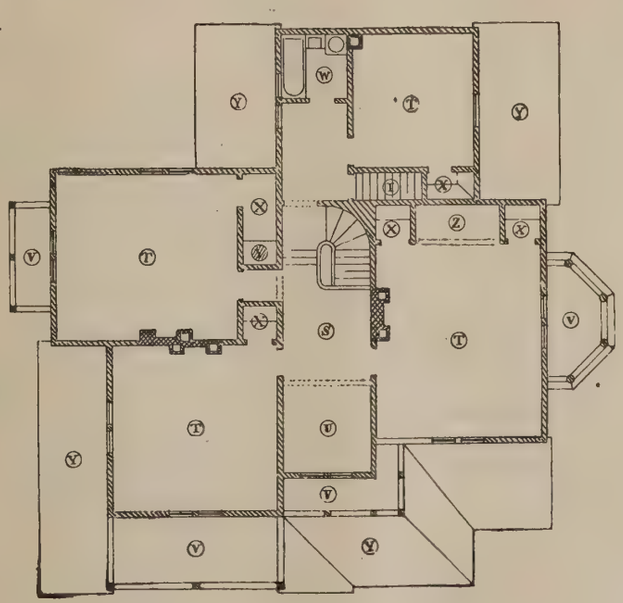


First-Floor Plan.



Second-Floor Plan.

DESIGN FOR SUBURBAN RESIDENCE, COSTING $4,500.

An Important American Industry.

Our attention has lately been drawn to several instructive articles in the public prints noting the remarkable growth of the manufacture of carpets in the United States, and which present a number of facts and figures relating thereto that are decidedly gratifying as evidences of what can be achieved by properly directed ingenuity, enterprise and energy, when aided by judicious protective laws, in building up an industry from small beginnings to the rank of a leading branch of manufacture.

In 1810, 9,984 yards of carpet and coverlids, worth $7,500, were made in Philadelphia. The carpet interests of the United States then consisted of one establishment in that city, owned by one William Sprague. But little headway was made in carpet manufacturing in the United States until the enterprise and intelligence of the late Mr. Bigelow succeeded in introducing certain improvements, and in 1845 the successful weaving of ingrain carpets by power was begun. From the successful experiment at Lowell, the manufacture of ingrain carpets in this country has been marked by nothing but its constant development. A few years later inventions for weaving Jacquard Brussels and Wilton carpets were completed, and the largest factory of this kind in the world was started. To America the honor of this achievement is due. Axminster carpets, adapted only for the most luxurious use, until recently made exclusively in France and England, are still woven in those countries on hand looms. Now 200,000 yards of these goods are annually made in this country by machinery—an amount believed to be equal to the entire annual production of the same kind of goods in France, and more than is made in Great Britain.

A writer in a late number of *America*, at some length points out how, one by one, the prejudices against American carpets have been removed—the designs, the quality of the dyes, and the finish—; and now even English rivals generously admit that in the production of Jacquard Brussels, tapestries and Wiltons, and narrow Axminsters, we have nothing to learn from them, either in design or fabrication.

A short time since the *Inter-Ocean* published the fact that seven years ago, Kidderminster sent twenty salesmen to this country in the interest of their well-known carpets, and that now no one is sent. Seven years ago England sent into the United States $5,727,183 worth of carpets; now her exports into this country are $367,105, a decrease of $5,360,078. The following table shows the decrease in the imports of carpets:

1872	$5,727,183
1873	4,388,257
1874	3,649,863
1875	2,643,932
1876	1,521,092
1877	674,011
1878	398,389
1879	367,105

Within a few years this industry has developed to such an extent that our production of carpets is now larger than that of any other country in the world. In 1871 England held the supremacy of the world in this line, but in robbing her of 40,000,000 customers here at home we have displaced that supremacy. The decline in English importations of Brussels tapestry has been even more marked than that of the carpets in general, as will be seen from the following, which we take from the *Carpet Trade Review:*

For the Fiscal Year Ending June 30, of	Square Yards.	Value.
1871–2	2,759,090	$2,339,781
1872–3	2,958,482	2,358,081
1873–4	2,099,301	1,890,959
1874–5	1,454,741	1,282,773
1875–6	546,958	492,580
1876–7	279,349	232,138
1877–8	94,253	85,595
1878–9	23,149	21,636

The decrease here is nothing short of startling, and, at the best, shows that the United States has utterly ruined the British carpet trade in this country. The census reports show that in 1870 there were manufactured in the United States 21,985,233 yards of carpet, including all kinds other than rag carpets. Below is the table showing the distribution of the manufactories:

	Total Number of Yards.
Connecticut	1,710,550
District of Columbia	1,273
Maryland	15,000
Massachusetts	3,341,560
New Hampshire	113,600
New Jersey	118,720
New York	4,425,288
Pennsylvania	12,257,742
Wisconsin	1,250
Total	21,984,983

Thus the production in 1870, when we were importing 6,882,456 yards from England, exceeded the total exportation of England by nearly 4,000,000 yards. In 1850 we made 7,857,636 yards; in 1860, 13,285,921 yards; in 1879, 21,985,233, and in 1880 it is fair to presume that the production will not be far short of 35,000,000 yards. In Philadelphia there are now employed upward of 7,325 persons in this industry, in 180 establishments; and in 1876 the product of our factories, according to Mr. Lorin Blodgett, of Philadelphia, was as follows:

	Yards.
Brussels carpet	370,400
Tapestry	900,000
Ingrain, all wool	6,018,909
Ingrain, cotton and wool	12,135,404
Venetian	1,582,206
Damask	1,894,836
Total	22,901,755

In 1876, the city of Philadelphia alone produced 1,000,000 more yards of carpets than were produced in the whole United States in 1870. According to an estimate made by the Carpet Association, the following is a resume of the product of 1875:

Philadelphia	$19,000,000
Other mills enumerated	11,376,168
Non-enumerated	2,000,000
Total value of American production of carpets in 1875	$32,376,168

New Publications.

Camp and Cabin. Sketches of Life and Travel in the West. By Rossiter W. Raymond, late U. S. Commissioner of Mining Statistics; editor *Engineering and Mining Journal.* New York: Fords, Howard & Hulbert. 1880. Price $1.

In this very pretty little volume, with the attractive title of "Camp and Cabin," are seen the evident results of Dr. Raymond's accurate observation, varied knowledge and quick intelligence, while his fidelity to fact does not interfere with his felicity of style. His sketches of life in California and Nevada are capital stories, alive with fun, full of incidental suggestion and information about the main business of life out there, and fairly permeated with the flavor of the humorous, reckless, good-natured, but dead-earnest kind of existence that prevails among the mining camps and cabins; while the tender touches of pathos show that he has not studied the bright side of life only. His sketches of travel—amid the wonders of the Yellowstone country, the peaks of the Rocky Mountains and the Ice Caves of Washington Territory—are no less interesting. His rapid but careful pen makes clear the notable features of the scenes he invites the reader to view, and shortens the weary approaches with charming discourse, ludicrous pictures of incidents by the way, brief scientific jottings of unfamiliar facts, merry philosophy, and, in short, such a pleasant commingling of wit, wisdom and poetry, as makes the reader envious of the companions of this delightful *voyageur.*

Dr. Raymond's reputation as a "story-teller" is not new, and one might be tempted to fancy, from the bright and airy style of his sketches, that his imagination had supplied the material for his talent as a *raconteur*, but that his ten solid volumes of "Reports" while he was U. S. Commissioner of Mining Statistics, stand as witnesses to his having at least "gone over the ground," and that to some purpose. To be technically accurate without being technically abstruse was their salient and acknowledged merit, and they did much to enhance the author's reputation as a scientific man. As to "Camp and Cabin," that is a delicate morsal to be enjoyed, and no one who reads it will fail to wish that there was more of it.

American Health Primers: Winter and its Dangers. By Hamilton Osgood, M. D. Philadelphia: Presley Blakiston. 1879. Price 50 cents.

Summer and its Diseases. By James C. Wilson, M.D. Philadelphia: Presley Blakiston. 1879. Price 50 cents.

These books belong to the series of "American Health Primers," issued in uniform style from the publishing house above named. The volumes already published, and those in course of preparation, cover quite a variety of subjects, and convey a large amount of exceedingly useful information about taking care of the health and avoiding preventable diseases. The authors of these "primers" are men who are eminent in the specialties which they discuss, and the work of editorial revision could not be in better hands than those of Dr. Keen. The purpose of this series of volumes, concisely stated, is to diffuse as widely and cheaply as possible, among all classes, a knowledge of the elementary facts of preventive medicine and the bearings and applications of the latest and best researches in every branch of medical and hygienic science. They are intended to teach people how to take care of themselves, their children, pupils, employés, etc.

The topics treated of by Dr. Osgood cover nearly everything relating to our habits and customs of living in the winter season, in the course of which he presents many cautions respecting what should be avoided as harmful, and gives sound advice on the subjects of errors in dress, carelessness and ignorance in bathing, danger from overheated air, indifference to sunshine, sedentary life and neglect of exercise, the dangers of school life in winter, winter amusements, and kindred matters.

Dr. Wilson's hand-book, on the other hand, takes up and deals in familiar and comprehensible style the troubles and diseases incident to the summer season. The following statement of the topics discussed by him will show how much there is of interest and value in his treatment of the subject. He treats, among other things, of sun-stroke and heat fever; of summer diarrhœa and dysentery; of cholera infantum; of summer and autumnal fevers; of summer colds and hay asthma; and of the skin in summer and its diseases.

This series of hand-books is admirable in design and excellent in execution. We can give them our unqualified approval as most useful aids in disseminating correct ideas of the more important facts of anatomy, physiology and hygiene, which have a direct bearing on our every-day life, and that of those dependent upon us, and in teaching the proper application of this knowledge to the preservation of the health and the avoidance of preventable disease.

How to Learn Short-Hand; the Stenographic Instructor. An Improved System of Short-Hand Writing. Arranged specially for the use of those desirous of acquiring the art without the aid of a teacher; being the simplest, most practical, and the best adapted for reporting. By Arthur M. Baker. 12mo, paper; 25 cents. S. R. Wells & Co., 737 Broadway, New York.

This is the latest manual published on the subject of short-hand writing. It claims to be based on the best and most successful of the older stenographic (as distinguished from the purely phonetic) system of writing. There are several new features introduced, the most important of which are a phonetic vowel scale and a method of showing the place of a vowel in a word, without using the phonetic vowel signs as in phonography, or breaking the outline of the work. These modifications are affirmed to do away with the chief objections to the old methods of writing. In addition to this, the work before us omits the phonographic distinctions of heavy and light stroke characters, and the three positions, which are certainly the two weakest points in phonography. The instruction is clear and readily understood, and "How to Learn Short-Hand" ought to prove useful to all engaged in literary work, or those desirous of taking fuller notes of lectures, etc., than they can possibly do with ordinary writing, no matter how much abbreviated.

Mills' Directory of Boiler Owners, Engineers and Steam Users in the Cities of New York and Brooklyn; containing Names and Addresses of over 6,000 Boiler Owners and Engineers. 1879–80. Published annually by James N. Mills, 165 Broadway, New York. Price $3.

So far as we have had occasion to refer to this work, it is an accurate and complete compilation of steam users for the cities named. The value of such a compilation as a handy means of reference by all persons whose business requires correspondence and communication with users of steam power, and especially by those who have occasion to sell goods to steam users, is self-evident. We can commend it to all such as a convenient and useful publication to have at hand.

Photographs of Seaside Houses. Messrs Bicknell & Comstock, of this city, have issued the first of a series of photographic views of attractive seaside cottages in miniature, the card containing twelve miniature pictures. The purpose of the enterprise is to afford to architects or intending builders of country and seaside villas the best, most attractive and meritorious designs of leading architects and builders. These miniature cards, with newest additions, will be issued from time to time.

The initial number of the new quarterly, *The Sugar Beet*, the announcement of which we published last month, has appeared. It makes a very creditable appearance, and is full of useful and instructive information on the technological, the political and industrial bearings of its special subject. The new journal may be had of Henry Carey Baird & Co., Philadelphia.

OTHER PUBLICATIONS RECEIVED.

Proceedings of the American Philosophical Society. No. 104. July to December, 1879. From the Society.

Proceedings of the Engineers' Club of Philadelphia. Edited

by Chas. E. Billin. Philadelphia: Published at the Rooms of the Club.

Second Annual Report of the Bureau of Statistics of Labor and Industries of New Jersey, for the year ending October 31, 1879. Trenton: State Print.

Upon a New Theory of the Retaining Wall. By A. J. Du Bois, Ph. D. Pamphlet, 27 pp. Reprint from the *Journal of the Franklin Institute*. From the author.

Annual Report of the Commissioner of Agriculture for the Year 1878. Washington: Government Printing Office. 1879. From the Commissioner.

Report on the Lands of the Arid Region of the United States; with a more detailed account of the lands of Utah. With maps. By J. W. Powell. Second edition; 195 pp., 4to. Washington: Government Printing Office. 1879. From the Secretary of the Interior.

United States Geological and Geographical Survey of the Territories. F. V. Hayden in charge. Reports for 1867 to 1873 and 1875 to 1876 inclusive. From D. B. Saxton, Carlisle, Pa.

Early Amber Cane. Paper from the Fifteenth Annual Report of the Massachusetts Agricultural College. By Prof. C. A. Goessmann. Pamphlet, 15 pp. Boston: State Printers. 1879. From Lewis S. Ware, Philadelphia.

Report on the Geology of the Henry Mountains. By G. K. Gilbert. (United States Geological and Geographical Survey. J. W. Powell in charge). 160 pp., 4to, with numerous plates. Washington: Government Printing Office. 1877. From the Secretary of the Interior.

Report of the Special Committee of the Chamber of Commerce of the State of New York, on Railroad Transportation, as to the results of the recent legislative investigation of railroad management in this State. New York: Press of the Chamber of Commerce.

Relations of Railroads to the Public. Report of the Committee on Railroad Transportation of the New York Board of Trade and Transportation, upon bills now pending in Congress to regulate commerce by railroad among the several States.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2601) Concerning Celluloid.—Referring to your review of the celluloid process, you say: "While thus under pressure the mixture is heated by means of a steam jacket surrounding the chamber, or by other means, to about 300°." How is it possible to get the heat above 212° in a steam jacket? Can it be done?—E. J. L., Glasgow, Scotland.

(2602) To Figure the Cost of Buildings.—Would you please advise through the columns of your journal the simplest way in which to figure the cost of buildings.—G. P. E., New London, Conn.

(2603) Manufacture of Lager Beer in Small Quantities.—If convenient, will you please give a recipe for the manufacture of lager beer in small quantities, for private use.—J. J., Philadelphia.

(2604) Carburetters.—I want to know if apparatus for carburetting or enriching common burning gas can be used in your city without special approval or inspection of insurance and gas companies? Can you tell me anything about it?—G. J. J., Steubenville, Ohio.

(2605) Elastic Limit.—Will you please explain what is meant by the term "elastic limit," as used in tests of iron, steel, etc.—E. H. H., Wilmington, Del.

(2606) Thermostat for Incubator.—I have an incubator, and want a thermostatic bar to regulate the valve. I have everything but the bar, and on that I am puzzled. Will you give me instructions how to proceed, or a sketch that will give me a start. My machine is 3 feet long and 18 inches wide, the water in the tank to be heated by a coal oil lamp. If you will give the necessary instructions to enable me to complete it, I shall feel grateful.—J. E. Q., Phoenixville, Pa.

(2607) Hydraulic Motor.—Will you have the kindness to define a hydraulic motor. We have had some discussion on the subject, and have referred its settlement to your definition. D. B. S., Carlisle, Pa.

(2608) Repoussé Work.—Will you please inform a reader of your journal what repoussé work is.—P. F., Jr., Augusta, Me.

(2609) To Reduce French Measures to Decimals.—I am, like many others, troubled for a simple rule to reduce French measures of weight into decimals. For example, 15 decigrammes, 4 centigrammes, 6 milligrammes, contained in 20 grammes, what per cent?—J. T., Newark, N. J.

(2610) Quantity of Air to Oxidize One Ounce of Lead.—What amount of atmospheric oxygen is required to oxidize one ounce of lead, to form litharge?—J. T., Newark, N. J.

(2611) Alloys of Iron and Zinc.—Have any alloys of iron and zinc been made and used? If so, what are they used for? —R. B McD., Galt, Ontario, Canada.

(2612) Easily Fusible Alloy.—Can you give me a recipe for a fusible metal that will melt below 100°?—R. B. McD., Galt, Ontario, Canada.

(2613) Non-Corrosive Ink.—I will thank you for a formula for a good ink that will not form a sediment or corrode steel pens?—C. H., Quakertown, Pa.

(2615) Cones of Pulleys.—Please give a rule for computing any size of cone pulleys to run together, so that the belts shall be tight on each one of them.—F. E. D., Dayton, Me.

(2614) Extent of Telegraphs.—I have maintained that the world is now entirely encircled with the telegraph, but was declared wrong. Will you decide the question.—L. S. W., Akron, Ohio.

REPLIES.

(2577) Velocity of Descent of a Rifle Ball Fired Vertically.—The answer given in our February number to the question "whether a rifle ball fired vertically would strike the earth with the same velocity that it left it," should be modified as follows. If the ball is fired *in vacuo*, Yes. If fired in the air, Yes—less the resistance of the air both in ascending and descending. The introduction of the factor of the resistance of the air into the calculation, complicates the question considerably; but a little reflection will convince our correspondent that the resistance of the air acts, if we may make the comparison, as a brake *both* ways—preventing the ball from attaining the hight it would otherwise reach, and on its return course preventing it from falling as fast. Table V., given in our February number, when applied with the explanation herewith given, will give values which must be subtracted both from the ascending and descending velocities, to get the correct answer.

(2586) Electric Battery from Metals Alone.—Since replying in last month's issue to the question asked by H. D. E. as to how he could construct an electrical battery from metals alone, we have been gratified to meet with the published account of a very decided advance in the construction of the thermo-electric battery made by the French electrician. M. Clamond, whose apparatus is illustrated and described elsewhere in this issue. We therefore refer H. D. E. to the article in question, which will probably give him some valuable hints.

(2601) Concerning Celluloid.—There is no difficulty in maintaining the high temperature we have named in our article. We infer from our correspondent's inquiry that he labors under the misapprehension that the temperature of steam generated in a steam boiler is constant at 212° Fah., whereas it is entirely dependent on the pressure—that the higher the pressure the higher the boiling point of the water, and consequently the higher the temperature of the steam. The following table gives at a glance the temperature of steam at different steam pressures:

	Temperature of Steam.	
Steam Pressure.	*Regnault.*	*Nystrom.*
14.7 pounds	212° Fah.	212° Fah.
25 "	240.07 "	241 "
50 "	280.89 "	282.8 "
75 "	307.42 "	309.8 "
100 "	327.6 "	329.9 "
150 "	358.4 "	360 "
200 "	381.8 "	382.6 "
300 "	417.7 "	416.5 "
400 "	445.1 "	441.9 "

From this table, E. J. L. will observe that a steam pressure of 75 pounds in the jacket would give a higher temperature than that required for the process of transformation or conversion in the manufacture of celluloid. By diminishing the pressure, on the other hand, the boiling point is lowered—that is, the temperature of the steam (or vapor) is reduced below 212°; thus, at a pressure of about ½ an atmosphere, or 7.35 pounds, the boiling point of water is lowered to 180°, and in vacuo it boils at 125°, or even lower. Both these principles are utilized in the arts; the high temperature of steam under pressure, for example, in the extraction of gelatine from bones, the vulcanization of rubber, conversion of celluloid, etc.; while the opposite process is constantly made use of in the arts to concentrate vegetable extracts, to distill volatile principles, essences, etc., under diminished pressure (or in vacuo), and consequently at a temperature below that at which they would suffer destruction by heating, or contamination from other substances from which they are to be separated. E. J. L. will observe from the foregoing explanations that the heating of a mixture (such as that described in our article) "by means of a steam jacket surrounding the chamber, to about 300°," is not difficult of accomplishment.

(2602) To Figure the Cost of Buildings.—In replying to our correspondent, we would say that there is no royal road for acquiring the information he asks for. The knowledge he seeks demands a practical familiarity with innumerable details, that can only be gained by years of actual experience. Often, indeed, this experience must be bought and paid for at high figures, and such experience is apt to be, in the long run, the most valuable in a double sense. There are, however, certain useful hints and facts which are all important as affecting the question of the cost of building operations, and which may be gleaned from published works on the subject; and access to such information may prove to be of the greatest assistance to one in our correspondent's position. We would therefore refer him to a work of this kind, written by a practical builder, which appears to us, so far as we have examined it, to more fully meet the requirements of persons seeking the sort of practical information our correspondent wants than any we have as yet met with. Its title is "The Contractor's, Builder's and Carpenter's Building Table and Estimate Book," being a systematic, thorough and practical method by which to estimate the cost of building, work and material, with full and complete instructions; together with a great variety of full bills of timber, giving the number of feet of frame timber contained in over two hundred buildings of various dimensions; also the number of feet of boarding, clapboards and shingles required to cover the same, with many other valuable tables for building piazzas, bay-windows, porticos, etc. By L. E. Brown, builder. This work we can furnish, postpaid, on receipt of $1.50.

(2603) Manufacture of Lager Beer in Small Quantities.—The following recipe, which is said to make an excellent beer for home use, may answer our correspondent's purpose. To make 5 gallons of beer, take somewhat more than that quantity of soft water, suspend in the vessel containing it a bag with about 2 ounces of hops, and boil for about half an hour; then add about 3 pounds of ground malt, or, if preferred, a quart of thick sugar syrup (or of molasses); allow the whole to boil up several times, then pour the decoction into a tub or vat. As soon as it has become say luke-warm, add to it about a half pint of good brewers's yeast, and allow the whole to remain in a cool place to ferment. At the expiration of six to eight days it will have become quite clear, and may then be bottled. This beverage may be made stronger or weaker, or more or less bitter, by varying the above proportions; and when prepared according to this recipe, is said to make a refreshing and pleasant drink, which will keep very well in a good cellar.

(2604) Carburetters.—So far as we know, the New York Board of Fire Underwriters make no serious objection to the use of carburetting apparatus, when they are devised with proper regard for ordinary conditions of safety. The insurance companies have a circular relating to the subject, which gives the terms and conditions to be observed and met by makers and users of these contrivances, before they will give their sanction. This circular we remember to have seen some years ago, and its terms and specifications are not at all unreasonable; so that, if you have a properly contrived apparatus, you should have no difficulty in getting the permission of the New York local Board of Underwriters to introduce it. The gas companies, we believe, interpose no objections to the use of carburetters.

(2605) Elastic Limit.—This is best explained by beginning with the meaning of the general property of elasticity. This is the property possessed by all bodies to a greater or lesser degree by which they seek to return to their original form after being acted upon by any force which tends to distort them. When the body immediately and perfectly recovers its original form when the distorting force has ceased to act, its elasticity is said to be perfect; when, however, the distorting force permanently alters the shape or figure of the body, its elasticity is said to be imperfect. No body is perfectly elastic, though some substances, like rubber or ivory, are nearly so; and all solids are elastic within certain limits. The meaning of the term "elastic limit" will now be readily understood from the foregoing. The "elastic limit" of any material represents the load which it is capable of receiving before it acquires a permanent set, and from which it will not recover and return to its original form on the removal of the load. As there are different kinds of strains to which bodies can be subjected—for example, tension, compression, flexure, and torsion, so we speak of limits to tension, compression, flexure and torsion, beyond which the addition of more weight, or the application of more force, will lead to permanent distortion or rupture. A full discussion of this and allied properties of materials used in construction, will be found in the numerous works on the "Strength of Materials," which will be found in any well stocked library.

(2606) Thermostat for Incubator.—We have replied to this correspondent by sending him sketches of several forms of thermostats that might answer his purpose, and expressing our preference for the mercurial thermostat over the thermostatic bar he desired to have sketched. We would be pleased to learn how the plan we suggested answered our inquirer's purpose. It may interest this correspondent to know that in France, where artificial hatching of domestic fowls is carried on more extensively than anywhere else, the use of thermostats for regulating the temperature is in many cases dispensed with altogether. The hatching box is thoroughly lined with felting or other heat insulating substance, and the temperature of the water is kept almost constant, the variation not exceeding 3° or 4°, by the addition say once every morning and evening of a certain quantity of hot water to make up for the cooling of the previous 12 hours. This method obviates the use of a stove or other heater, but necessitates a considerable body of water and excellent insulation. The amount of cooling suffered during a given period, and the amount of heated water necessary to be added to restore the normal temperature, must first be ascertained by a few days' experiments. Then there will be no further trouble on this score, as the amount of heat lost will remain practically constant from day to day. The arrangement is reported to us, on the authority of eye-witnesses, to work exceedingly well, though we are not prepared to vouch for it.

Since penning the above, we have received a reply from this correspondent to our letter above referred to, announcing his satisfaction with the suggestions made therein, and accompanied with a sketch, showing that he has correctly understood and ingeniously applied one of the devices suggested by us. We reproduce this letter, simply because we wish to make it

the text of a few remarks concerning this department of our journal:

"*Dear Sir:* Your valuable letter received and carefully read. I thank you for the information given in my case; I believe it has solved the problem I was working at. Enclosed please find sketch showing how I will apply your idea, and I feel certain it will work first rate. The dotted line shows the bottom of the hot-water tank, and immediately below I have placed the glass bulb and tubing between it and the egg drawer, so that any variation of heat will affect the ether and thereby operate the lever and thereby cause the damper to open to allow the heat to escape through the central ventilator. This ventilator extends through the tank and opens in the egg chamber. The wheel shown carries four pins, placed in such a manner as to correspond to the vibrations of the lever. When expansion takes place, the lever is forced down until the pin passes the lever, when the weight attached to the cord surrounding the drum of the damper shaft brings the next pin up against the lever, and so on until the chicks are released from the shell. I have also made a sketch of the inside of the water tank, with the top removed. The lines through the middle are intended to represent partitions just as high as the sides, and the red is intended to show the circulation of water heated in a separate boiler. Instead of the cord and weight a spiral spring might be used. I shall be very glad to hear from you, either by letter or through the columns of your valuable journal. J. E. Q."

This letter, which we select from many of like tenor on file in our office, gives us the opportunity of saying that we are particularly solicitous to make the Query Department of our journal a really serviceable vehicle of communication for the interchange of useful information between our readers and ourselves, and between our readers themselves. We spare no trouble in the task of making the replies we proffer as strictly reliable and useful as our knowledge of the subjects, reinforced by an extensive library of reference, can make them; and our reward for the expenditure of much time and patience in solving the frequently puzzling conundrums that are propounded to us from month to month, is ample, when (as it occasionally does) it comes in the form of some hearty acknowledgement that we have really been helpful in our efforts to meet our correspondents' wants. We lay no claims, however, to infallibility, and from the extent of the ground covered by the queries that are received and replied to, it would be surprising if, in spite of much care and patience expended upon them, errors should not occasionally find their way into the replies that we proffer. On this account, as well as to increase the interest and value of this department, we take this opportunity of personally reiterating the request at the head of this department, that whenever our readers find anything to question in our replies, or, as must frequently happen, have fuller or more suitable replies to offer, they will not hesitate to send in their communications, receiving our assurance that they will always be welcomed.

(2607) Hydraulic Motor.—A hydraulic motor may be defined in its most general acceptation, and in the fewest words, to be a "water engine." Knight, in his "Mechanical Dictionary," defines two forms of hydraulic motor, namely: 1. A hydraulic ram having connections which raise a piston that is forced down by atmospheric pressure at each cessation of the downward flow of water. By suitably arranged valves the water may be admitted alternately above and below the piston, causing a reciprocating action similar to that of the steam engine. 2. A machine in which a piston is moved in a cylinder by water from a head or stand-pipe, in the manner of a steam engine. The same authority refers to hydraulic engines on the continent of Europe, that work with a head of 200 feet.

(2608) Repoussé Work.—Repoussé work is the name given to a peculiar kind of decorative work in metals, that may be called a kind of chasing. It is done entirely by the hammer. The workman uses a plain flat sheet of metal, having before him a model of the article to be produced. The plate rests upon some plastic composition, and with a small hammer the workman produces indentations on the inner surface of the plate, corresponding to the design. A small steel punch is sometimes employed, and if the relief is accidently made too high, it is reduced by counter hammering. Superb artistic works in metal are made by this process.

(2609) To Reduce French Measures to Decimals.—The simple Rule of Three suffices to solve the problem our correspondent propounds, if we correctly understand him. His example, as we read it, requires to know what per cent of 20 grammes, 15 decigrammes, 4 centigrammes, and 6 milligrammes is. He has simply to apply the following rule of proportion: 20 grammes bears the same relation to 1.546 grammes as 100 grammes to x, and the value of x will be the percentage required. Thus: $20 : 1.546 :: 100 : x$; or,

$$x = \frac{1.546 \times 100}{20} = 7.73 \text{ per cent is the correct answer.}$$

(2610) Quantity of Air to Oxidize One Ounce of Lead.—It will require .07729 of an ounce (about $\frac{1}{12}$ oz.) of oxygen to completely oxidize 1 ounce of lead to the state of the protoxide called litharge. This weight of oxygen represents, at 60° temperature and 28.98 inches pressure, a volume of 98.6 cubic inches (or nearly 100 cubic inches). And as oxygen forms about one-fifth by volume of the atmosphere (the remaining four-fifths being nitrogen, and trifling amounts of impurities) we must multiply the above volume of oxygen by 5 (or, more correctly, by 4.76) to get the volume of atmospheric air to which it corresponds. Performing this operation, we find that to oxidize 1 ounce of lead to litharge will require 469.34 cubic inches of air. The mode of reaching this result is given below. The chemical equivalent—that is, the relative combining weight, of lead=103.5, and that of oxygen is 8. Litharge contains 1 equivalent of lead and 1 of oxygen; therefore we have the following proportion: If 103.5 parts (ounces, if you please) of lead require 8 ounces of oxygen for oxidization to litharge, then 1 ounce will require x parts—that is, $103.5 : 8 :: 1 : x$; or

$$x = \frac{8 \times 1}{103.5} = .07729$$

Which shows that 1 ounce of lead requires, to form litharge, .07729 of an ounce of oxygen. This corresponds to ($.07729 \times 437.5 =$) 33.81 grains. We now require to know the volume of 33.81 grains of oxygen at the above pressure and temperature. This we can get very readily, since we know by actual determination that the absolute weight of 100 cubic inches of oxygen is 34.29 grains. We then have the following proportion: If 34.29 grains of oxygen measure 100 cubic inches, 33.81 grains of oxygen will measure x; that is,

$$x = \frac{33.81 \times 100}{34.29} = 98.6 \text{ cubic inches.}$$

In other words, it will require 98.6 cubic inches of oxygen to oxidize 1 ounce of lead. We know by actual determination that 100 volumes of air contain (very nearly) 21 volumes of oxygen. To find the volume of air which would contain 98.6 cubic inches of oxygen, we would therefore have to multiply this quantity by

$$\frac{100}{21} = 4.76;$$

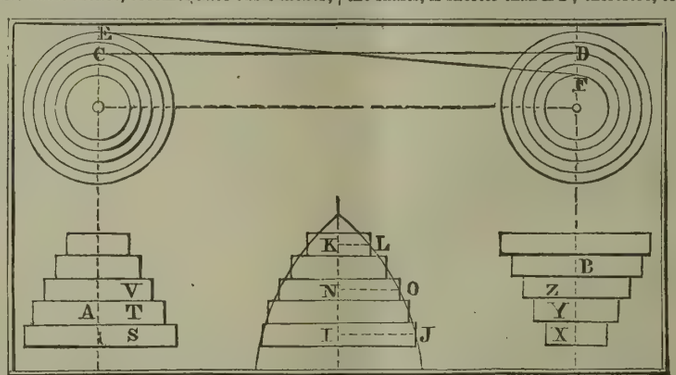
performing which, we have $98.6 \times 4.76 = 469.34$ cubic inches of air—the required answer at the temperature and pressure above named. We have calculated this answer for the ordinary temperature of 60° Fah., which will no doubt be what our correspondent wants. He will understand, of course, that if he wants the result at a different temperature, while the *weight* of the oxygen (0.7729 oz.) required *will remain unchanged*, the *volume* which this weight occupies *will vary*. By applying the rule that the volume of a permanent gas increases $\frac{1}{491}$ for each degree of the thermometer that it is heated, and diminishes in the same ratio for each degree that it is cooled, he will be able from our answer at 60° to calculate the volume of air necessary for any temperature he may want. Thus, at normal pressure, and at the freezing point (32° Fah.), the volume of oxygen which at 60° was 98.6 cubic inches, becomes 92.98 cubic inches; and that of the air, which at 60° was 469.34 cubic inches, becomes 442.58 cubic inches.

(2611) Alloys of Iron and Zinc.—The alloying of zinc and iron is very difficult, and we know of no alloys of these metals that have been made or used in the arts. The trouble seems to lie in the fact that at the temperature at which iron melts, the zinc is rapidly volatilized; and if it (the zinc) is added to a bath of molten iron, it decrepitates, and is cast out of the bath by the violence of its volatilization, and not a trace of its presence will be found in the metal. By taking the special precaution of introducing the zinc beneath the surface of a bath of melted iron through a well heated iron tube, alloys of these metals have been formed, but they have only a scientific interest, and are of no account in the arts. When iron is left for some time in contact with molten zinc—as, for example, in the process of galvanizing—a portion of the iron is dissolved and forms an alloy of zinc and iron, which appears to have a definite constitution of 21 zinc to 1 iron. If the iron is left long enough in the zinc, it will entirely disappear. This alloy appears to be of little use—it is coarse-grained and brittle. It has lately, we believe, come into use (as an impure zinc) in the refining of base bullion where commercial zinc was hitherto used. For this purpose it would appear to be well adapted, and has the advantage of cheapness.

(2612) Easily Fusible Alloy.—A fusible alloy that melts at a temperature below 200° Fah., is that of the elder Rose, and is made of—bismuth, 2 parts; lead, 2 parts; tin, 2 parts. It melts at 93° C. (or about 200° Fah.) By varying the proportions of these constituents, other but less fusible metals result. By adding one-16th part by weight of mercury to the alloy just named, its point of fusion is lowered slightly below 100° Fah. By the addition of varying proportions of mercury to any of the fusible alloys, we may state, their points of fusion are reduced in proportion; but they are rendered unstable by reason of the tendency of the mercury to leave them. An alloy of 2 parts bismuth and 4 of lead, thrown into a crucible containing mercury, will become solid on cooling, but will melt by simple friction.

(2613) Non-Corrosive Ink.—Almost any of the aniline colors, dissolved in a sufficient quantity in water, to which a trifling quantity of alcohol may be advantageously added, will give an ink of almost any desired tint (green, purple or black) that may be desired. They do not deposit, nor do they corrode the pen. A very good and easily prepared black ink, that has the advantage of cheapness also, may be made after the method of Runge, from logwood and neutral chromate of potassa. His formula is: Extract of logwood, 15 parts; water, 1,000; chromate of potassa, 1. Dissolve the logwood extract in 900 parts of water, allow it to deposit, decant off the supernatant liquid, heat to boiling, and add, drop by drop, the chromate of potassa dissolved in 100 parts of water. Runge's ink forms a deep black fluid, which does not corrode steel pens. It has the objection, however, that when exposed to the air it sometimes decomposes and deposits its coloring matter in clots or flakes. This difficulty, it is said, may be overcome by adding to the decoction of logwood, before the addition of the chromate, a few crystals of common soda (carbonate of soda).

(2614) Cones of Pulleys.—Our correspondent will find below a full and explanatory answer to his question, extracted nearly *verbatim* from Mr. John H. Cooper's excellent book on "Belting," to which we can refer him, with the assurance that he will find it strictly reliable and replete with useful information on everything relating to the transmission of power by belts and ropes. The publishers (Claxton, Remsen & Haffelfinger, Philadelphia) have kindly supplied us with the engraving illustrating this answer. When two cones of pulleys, or "stepped cones," are made alike—that is, with equal steps, such that the sum of the diameters of each belted pair is the same, a *crossed belt* will run with equal tension on any pair so made, when the shafts are parallel and the cones reversed; but an *uncrossed belt* will not so run on such cones. To show why the open belt will not have equal tension on all the pulleys, let A B be two equal stepped cones on parallel axes A E and B D. Now, if the sum of the diameters of the extreme pulleys E and F be equal to the sum of the diameters of C and D, the connecting strips E F and C D of the belt will be equal, because the enrolled parts are equal by the construction of the cones; but E F and C D cannot be equal, because they are not parallel, and hence it plainly appears that C D, being at right angles to the shafts, is shorter than E F; therefore, to preserve a certain



tension of the belt when on the extreme pulleys, the middle pulleys must be larger than the size given by equal steps in order to take up this difference. To find the proper diameters of the intermediate pulleys for open belt cones, first get, by Rankine's rule (given below), the radius N O from the given radii I J, K L, and distance between shafts, and through the points J O L describe a circle arc, upon which draw the faces of all the pulleys in the series as shown. Make both cones by this rule, and an open belt will run upon them with equal tension. Unequal cones may be made in like manner by drawing two similar cones, and then using, say S T V of the large end of one, and X Y Z of the small end of the other, as needed to serve the purpose. For wheels driven by round bands in V grooves, the same rules apply, observing that the *effective* diameters must be taken at the line of *band contact* in the grooves, which are the acting circles of adhesion. All the grooves must be alike, and should have concave instead of straight sides, like a Gothic arch, and the band must not touch the bottom of the groove.

Rankine's Rule.—When the belt is uncrossed, use a pair of equal and similar conoids tapering opposite ways, and bulging in the middle, according to the following formula: Let c denote the distance between the axes of the conoids; r_1 the radius of the larger end of each; r_2 the radius of the smaller end; then the radius in the middle, r_0 is found as follows:

$$r_0 = \frac{r_1 + r_2}{2} + \frac{(r_1 - r_2)^2}{6.28\,c}$$

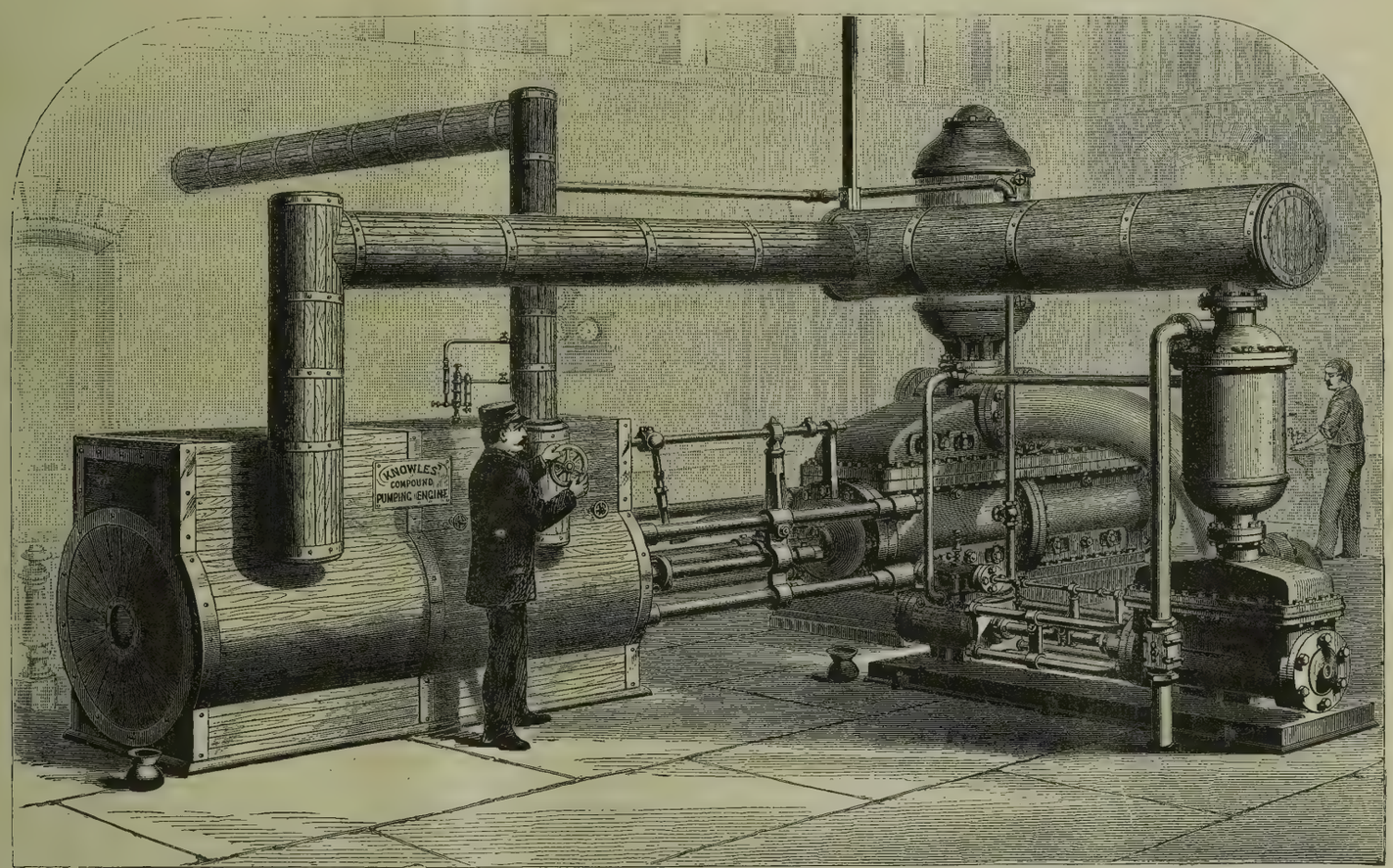
(2615) Extent of Telegraphs.—You were wrong There is still one "missing link" necessary to complete the electric circuit around the world, and that is the section that would be represented by a submarine cable across the Pacific from the American continent to Asia. Several projects for a cable from San Francisco to China and Japan *via* the Sandwich Islands have been mooted from time to time, but thus far nothing has come of them. The construction of this link is bound to come sooner or later, but until then you are in error.

THE MANUFACTURER AND BUILDER

Vol. XII.—No. 5. MAY, 1880. TWELFTH YEAR.

Knowles' Improved Compound Pumping Engine.

The wants of growing towns in respect to water supply have been the stimulus for the exercise of much ingenuity on the part of certain of our manufacturers, the problem being to devise a pumping engine which should combine the qualifications of simplicity of construction, economy of operation, and comparative high duty, with the important element of moderate first cost. To supply an apparatus, therefore, possessing these necessary qualifications to adapt them to the wants of localities where the heavy outlay for the more elaborate and costly "Cornish" and rotative engines generally used in large cities, is a field of enterprise upon which a number of our leading manufacturers have competed in friendly rivalry for years, the result being the production of pumping engines, which, in point of compactness, simplicity, effectiveness and comparative cheapness, leave little to be desired.



IMPROVED COMPOUND PUMPING ENGINE.

We present in the accompanying engraving an excellent representation of the class of machinery above referred to, which has acquired a wide reputation at home and abroad as a superior pumping engine for water-works. The direct-acting compound engine in question is designed and manufactured by the well-known Knowles Steam Pump Works, of New York and Boston, and has the following dimensions: High-pressure cylinder, 20 inches diameter; low-pressure cylinder, 38 inches diameter; water cylinder, 20 inches diameter; stroke, 36 inches; capacity when running at average speed, 2,000,000 gallons of water per day. There are now two pumping engines of this size in operation—one at the Chicago water-works, and one at the Newport (R. I.) water-works.

This apparatus is claimed by its makers to combine in its design and construction all the advantageous features possessed by other machines of its class, and to have peculiar merits of its own. There is no jar or concussion in pumping, an annoyance that is commonly met with in most grades of pumping machinery; the water passages are direct and roomy, the valve openings have large area, and the pump gives excellent results at the extreme ranges of speed and pressure. It will be noticed that the air pump is not connected to the engine, but forms, with the condenser, a symmetrical and well designed independent apparatus. The advantage of this arrangement is that the vacuum can be secured before the pumping engine is started. It is also more economical in the use of steam than if connected, as its speed can be correctly adjusted to the requirements of the main engine.

Summing up its claims to excellence and adaptability for the special service named in the preceding paragraphs, they may be stated to be that it embodies the economical advantages of the compound principle without that complication of parts which characterizes the more costly and elaborate water-works engines; it requires no costly engine-house or massive foundations, its running expenses are low, and its duty of the highest grade. In brief, it is a compact, well designed and effective water-works pumping engine, which will be found eminently adapted for its intended uses.

The United States Signal Service, we learn from (London) *Nature*, has recently had a high and well-deserved compliment paid to it. The German government, it appears, recently addressed, through the German Minister at Washington, a letter requesting to be exactly informed as to the processes by which the Signal Service Bureau so promptly collects at the War Department the meteorological reports from all parts of the United States—an extent of territory nearly as large as Europe—and so rapidly drafts and publishes them upon the printed daily weather map. These maps are issued three hours after the records are read at the distant stations. When it is remembered, says *Nature*, that this request comes from a government noted for its skilled chartographers, and standing first in Europe, the value of the compliment will be appreciated. It is understood that the German government proposes an advance in meteorological work. The information sought has been minutely

prepared by the chief signal officer, General Mayer, with the approval of the Secretary of War.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

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Agencies where the Manufacturer and Builder can be Found on Sale.

The following News Companies in the principal cities of the United States and Canada are agents for the sale of the MANUFACTURER AND BUILDER, and are prepared to supply the same promptly:

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Toronto News Co., Toronto, Ontario, Canada.
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The Business Outlook.

The decline in prices of many kinds of manufactured goods, which has been making itself felt for the past month or two, has given rise, in some quarters, to the fear that the general business of the country was about to receive a permanent set-back. A little reflection will suffice to show that such alarms are quite groundless, and that the present check in prices is simply one of the natural consequences of a somewhat too rapid revival from the prolonged depression from which the industries of the country were impatiently chafing to be relieved. It would have been contrary to all previous experience, if, after wating so long and anxiously for the good time coming, when at length it actually came, our business men had contented themselves to make haste slowly.

Unless, however, the newly awakened prosperity of the country is a delusion and a snare, such a thing as a permanent check to our industries at the present time is simply impossible, and the temporary halt in the upward movement of prices will doubtless prove to be beneficial rather than injurious, in giving timely warning of the dangers to be apprehended from reckless speculation and the undue inflation of values, the tendency to which it seems to be impossible to resist in periods of suddenly reviving industrial activity.

The evidences of solid prosperity throughout the country are too manifest to be mistaken, and barring some unforseen disaster, this healthy condition is likely to continue for a long time to come.

Editorial Reflections.

That seasons of suddenly reviving prosperity are not without their peculiar dangers, is a truth that is receiving abundant verification in what is daily taking place about us. Rejoicing to be freed from the hateful burden of dullness that had hung like a millstone about all their undertakings, men are prone, at such times, to look to the future with too much confidence. There are no clouds in their horizon, or, if there be any, the leaden palor they were wont to wear has given place to the roseate hue of promise.

The careful habits and prudence, born of the time of adversity, with which they had been used to scan new projects and analyze new enterprises, and to weigh the probabilities of success or failure with clear judgment and deliberation, have been supplanted by a newly born enthusiasm, to which all that glitters seems like gold. Common sense seems for a time to have been laid aside, and men are disposed to lend a willing ear to the most incredible things if they only promise unheard-of returns. Even the most prudent are not altogether proof against this element of demoralization, and the methodical habit of former days too often yields to the pervading spirit of speculation; and the wild idea of gaining wealth by sudden and unusual methods, is an infectious disease from which no class of the community is altogether exempt. It is the season which quacks and humbugs find most propitious; when inventors of preposterous motors, projectors of gigantic enterprises, blowers of mining bubbles, and all the host of charlatans and cheats descend upon the land like the plagues of Egypt, and for a little while fatten on the credulity of its people.

Those of our readers who are observing enough to take note of the currents of public temper, will recognize in this picture a likeness to the condition of things about us to-day.

We were tempted to the above reflections by reading in one of the daily papers of this city the following remarkable advertisement, which most aptly and forcibly illustrates the spirit of the time. It runs as follows:

"I have an invention by means of which I can propel a loaded car safely one thousand miles an hour. I desire to form a stock company with $50,000 or $100,000, to pay for taking out patents and putting the invention in operation. Persons desirous to invest in the stock, may address," etc., etc.

We have no doubt this most ludicrously extravagant announcement is not a joke, but a bait deliberately thrown out to fish for gudgeons, by some shrewd and unscrupulous knave, who is keen enough to understand that just now the temper of the time is such that no story—provided only it promises a quick and royal road to fortune—is so extravagant that it may not find eager believers.

The form of demoralization which we have here endeavored to depict, is, as we stated at the outset, the peculiar danger that inevitably accompanies the rapid revival of prosperity; but, like every other extreme manifestation, it is happily short-lived, the folly of reckless speculation is soon perceived, and prudence again asserts her accustomed sway. But in the interim the bleating of the shorn lambkin is heard in the land.

Organization of the American Society of Mechanical Engineers.

Since the appearance of our April number, the American Society of Mechanical Engineers has been fully organized, by the adoption of a code of laws and regulations and the selection of officers. The society may now be considered as ready for active work, and from the character of many of the names of those who have participated in the movement, we are led to expect much of it in the way of raising the standard of the mechanical engineer's profession in this country by establishing that *esprit du corps* that comes from organization, and in fostering and promoting that professional pride in excellence of achievement which such an organization alone can do, by criticism, discussion, interchange of opinions, friction of ideas, and the knowledge it affords its members that there is now at last a court of appeal to which the merits of professional questions may be submitted without fear or favor. We heartily wish the new organization a long career of usefulness.

The following is a brief statement of the proceedings as they have been narrated: The meeting for organization was held at the Stevens Institute, on Wednesday, April 7th. Owing to the absence of Mr. A. L. Holly, the chairman of the preliminary meeting before noticed, Mr. H. R. Worthington was chosen to preside, and Mr. J. C. Bayles was elected to act as secretary. Rules prescribing the conditions of membership, as reported by a committee on revision, were presented, and, after some discussion, adopted. They divide the membership of the new society into four classes, namely, members, honorary members, associates, and juniors. Full membership is to be restricted to mechanical, civil, military, naval, mining and metallurgical engineers and architects, and to be eligible a candidate must be considered competent to take charge of work as designers or constructors, or must have been identified with professional work either as teachers or investigators.

Honorary members, to the number of twenty-five, by the rules, may be selected from the ranks of the profession among those who have attained to professional eminence, and who have retired from practice.

A third class, designated as associates, will comprise persons having such knowledge of, or connection with applied science as will qualify them to co-operate with engineers in the advancement of professional knowledge.

Junior members will, finally, be such as have had at least two years' practical professional experience, or who are graduates of an engineering school, and will be eligible in time to full membership.

The business affairs of the society are to be managed by a council, composed of the regular officers and a Board of managers. The following officers were elected by the meeting: President, Prof. R. H. Thurston; Vice-Presidents, H. R. Worthington, Coleman Sellers, E. B. Coxe, Gen. Q. A. Gillmore, Wm. A. Shock, U.S.N., and A. L. Holly; Treasurer, L. B. Moore; and nine Managers. The Secretary's office, to be subsequently filled, will be a salaried one. It was agreed, also, that the society should copyright all papers ac-

cepted and read before its meetings, but that authors should be allowed the freedom of giving copies of their papers to newspapers for publication after they shall have been read.

The organization of this society, which promises to attain to much usefulness, is understood to be largely due to the efforts of Prof. J. E. Sweet, of Syracuse, N. Y., well known from his long connection with Cornell University, and his numerous professional publications. It has been suggested, as a mark of courtesy to this gentleman, that he be invited to read the first paper before the new society.

The Question of Food Adulteration.

There is no subject respecting which there is greater demand for wise and prudent legislation than that which heads this article. In some localities, notably in the city of New York, very sensible laws have been enacted, and the effect of their enforcement has been of great advantage to its people in protecting them against the dangers of the injurious falsification of staple articles of food and drink; and there may be isolated cases elsewhere throughout the country where similar results have been attained. But the question is generally ignored, and the people are left to be their own judges of the wholesomeness of their food supplies. There is good reason for this seeming indifference—namely, the great danger that laws enacted for inspecting and regulating the sale of such commodities, if not wisely framed and as wisely enforced, will be apt to become in practice such troublesome and vexatious hindrances to trade and commerce, that the evils springing from them will more than counterbalance the good.

Hence, it has occurred that while many of our communities have enacted laws respecting this important question, there is little or no uniformity, either in their tenor or the manner of their enforcement, and in most cases these laws have been framed with an utterly inadequate idea of the necessities of the case, and their enforcement has so clearly shown their inadequacy that they have been allowed to stand a dead-letter on the statute book. In many localities the question has been simply ignored, in deference to the mistaken notion that in such matters people ought to be able to take care of themselves.

There are enthusiasts who, with more zeal than knowledge, now and then play upon the fears of the community with terrible stories of the wholesale falsification and poisoning of almost every article of food and drink that enters into consumption; but their palpable ignorance, and gross exaggerations of the truth, do more harm than good in hindering the rational treatment of the food adulteration question.

To secure sensible legislation upon this subject, such legislation as shall have the merit of accomplishing the purpose of protecting the public against the dangers of injurious food adulterations, that shall be uniform in their character, and that shall not impose unnecessary and troublesome restrictions upon trade, is a task as difficult to perform as it is important.

We observe that the National Board of Trade has been giving this subject some consideration, and at its annual meeting, held at Washington, December 12th, 1879, decided to offer a prize of $1,000, to be awarded in open competition for the best draft of a "Food Adulteration Act." The text of the preamble and resolution adopted is given below:

"*Whereas*, The public mind has of late been considerably agitated by the alleged general adulteration of food; and,

"*Whereas*, The question of pure and wholesome food and drink is one of great importance to the people of the United States; and,

"*Whereas*, Local attempts to regulate the sale of food have, on account of limited jurisdiction or other causes, generally proved inadequate for the purpose for which they were designed, and it is, therefore, important that wise laws (if possible, national in character) should be enacted which will afford adequate protection both to consumers and honest manufacturers; and,

"*Whereas*, A member of this Board offers to place $1,000 at the disposal of the Executive Council of this Board for a prize or prizes to be given for the best act or acts, accompanied by an essay, designed to prevent injurious adulteration and regulate the sale of food without imposing unnecessary burdens upon consumers; therefore, be it

"*Resolved*, That the President of the National Board of Trade be authorized to appoint a committee of experts, to be composed of five members, one of whom shall be a member of the medical profession, one a chemist, one a member of the legal profession, and one a merchant; said committee to examine and pass upon the merits of any acts or essays which may be submitted to them, and to award prizes therefor. The committee, as soon as possible after their appointment, to make public the necessary conditions, and when their labors are completed, to place in the hands of the President of this Board an act designed to accomplish the purpose above described."

For the information of our readers, we add the following details respecting the terms of the competition: The aim of the committee is to obtain the best essay upon the subject of adulteration of food and drink in the United States, together with drafts of State and National laws relating to this subject. The object to be kept in view in preparing the essay, it is explained, should be to show, (1) what are the usual deleterious adulterations of articles of food and drink in this country; (2) the effect of these adulterations on health and on trade; (3) the best means of detecting and preventing their recurrence with the least interference with commerce, and with the least expense to the community; and (4) the reasons for the legislation proposed. The draft of laws must be in such form that they can be at once submitted to State Legislatures and to Congress for adoption. The different essays and drafts of bills must be written in legal form on foolscap paper, the writing to be only on one side of the sheet. The draft of the law must be on separate sheets from the essay. It is desirable to have side references summarizing the contents of each paragraph for convenience of examination. All extended quotations or citations of authorities must not appear in the body of the text of the essays, but be placed in an appendix by themselves. The name of the author of the essay or bill is not to appear upon it, but each one is to be marked with a selected word or motto to distinguish it. This motto, together with the author's name, is to be enclosed within a sealed envelope, endorsed, "To the Committe of Awards on Food Adulteration Act," and this sealed envelope is to be enclosed within a second envelope, sealed, and endorsed, "To the Editor of the *Sanitary Engineer*, No. 140 William street, New York." This sealed envelope will be kept unbroken until after the Committee of Awards have rendered their decision. The time for the competition is limited to the 1st day of October, 1880, at noon.

The Committee of Award will consist of Surgeon J. S. Billings, U.S.A.; Prof. C. F. Chandler; ex-Chancellor B. Williamson, Elizabeth, N. J.; A. H. Hardy, Boston; and John A. Gano, Esq., Cincinnati. The Committee of Award, on or before the 15th day of November next, if practicable, will select from such as are meritorious, three essays and drafts of bills, and number them consecutively in the order of their merit as determined by the judgment of the committee, or by a majority of them. To the author of draft and essay No. 1, will be paid $500; to the author of draft and essay No. 2, will be paid $300; to the author of draft and essay No. 3, will be paid $200. The Committee of Award reserve the right to publish any portions of the essays or drafts submitted to them, which, in their view, may aid in the furtherance of the objects for which the competition was instituted.

We look upon this announcement of its intention, by so influential a body as the National Board of Trade, as the first step towards accomplishing the much needed rational and uniform legislation upon the question of food adulteration. Even should its efforts prove unsuccessful at this time, they will not be entirely lost, since they cannot fail to awaken an interest in the subject, and an appreciation of its importance in many quarters where the subject will be discussed, and of these seeds dropped by the wayside some will doubtless fall upon good ground and bear fruit.

From the fact of the practical independence of the several States of our Union in everything that relates to their internal government, the task of securing such uniformity as is contemplated in the announcement of the Board, is made specially difficult. Whether federal legislation, as is contemplated in the announcement, could or would not be trenching upon the reserved rights of the States to regulate their own domestic affairs, are questions of constitutional law, which we are not competent to decide. Should it be competent for Congress to enact laws of this character of universal applicability, the problem would be much simplified; but, as appears to us most likely, the legal aspect of the subject will necessitate the reference of any law or laws the Board may draft to the legislatures of the several States for their separate approval, a circumstance which materially increases the difficulties of securing common action.

In some European countries, where such difficulties as those above dwelt upon do not exist, admirable laws respecting the adulteration of food are in operation with the happiest results. In England, notably, the food adulteration acts are highly to be commended, and their enforcement is insured through the co-operation of a special expert class—the public analysts—officially created for the purpose.

We shall await with interest the result of the action of the National Board of Trade, in the hope that it may accomplish something substantial in this matter.

The Interoceanic Canal.

The course of our government in dealing with the interoceanic canal question, will be watched with anxiety by all who feel an interest in the accomplishment of this great work. M. de Lesseps, since his return to France, is reported to have expressed the greatest confidence that he had succeeded in securing the warmest sympathy for his particular project among our people; that he was assured of substantial contributions to the stock of his company, and that the expressions of hostility which his agitation of the question evoked at Washington, were merely the harmless vaporings of politicians whose utterances in no wise reflected public sentiment.

We do not know whether M. de Lesseps is correctly reported, but if the above statements which are credited to him, were actually made, either we have greatly overestimated his capacity as a diplomat, or M. de Lesseps, to use a homely phrase, is "whistling to keep his courage up." M. de Lesseps, while in this country, was everywhere courteously received, as befitted a person of his distinguished reputation, and he was afforded every opportunity to present the advantages that would accrue to this country through the execution of his project; but we have yet to hear of any warm encouragement that he received, or of a single dollar that was subscribed to his fund. The newspapers, which rarely go counter to public opinion, almost unanimously opposed his project, and at Washington he met with no better success than to materialize the ghost of the Monroe doctrine. The London *Times* shows a proper appreciation of the situation, when it says, in a late review of the question, that Lesseps' visit to the United States has given the death-blow to his enterprise.

But while M. de Lesseps' project may probably be considered as definitely shelved, the strong disposition of Congress to take up the subject, and to legislate upon it in the interest of "a canal under American control," by no means carries with it the assurance that we shall ever see it realized. The abrogation of a treaty, inimical doubtless to our interests, which is now talked of, is not accomplished in a day, and the relegation of the affair to the Department of State, which now seems not unlikely to be done, may, as likely as not, have for its result the strangling of the newly born project in the meshes of red tape.

We shall hope, however, for the best, and while we confess that we should prefer to see the canal built by almost any one with pluck and energy enough to do it, to running the risk of having it indefinitely postponed under pretence of protecting American interests, we

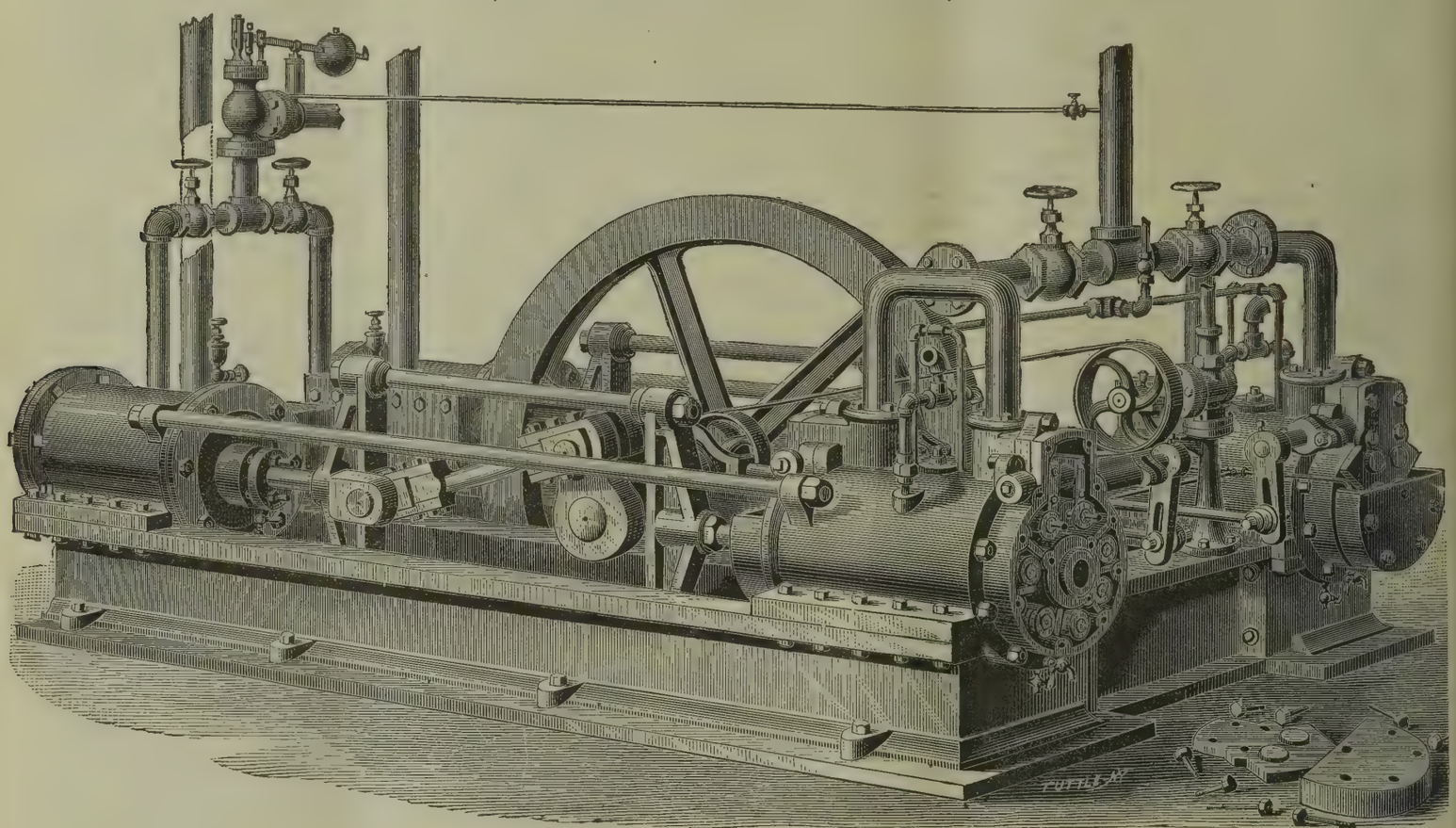
earnestly trust that, having assumed the right of controlling a work of such magnitude, we may not fail in the duty of speedily executing it.

Improved Air Compressor.

The earliest references to the Clayton air compressor which were made in this journal, will be found in our issue for January, 1877, where the general principles of its construction and operation are set forth in detail. This was followed in January of the current year by a second article, in which it was noticed that the manufacturer had materially improved the details, and consequently the effectiveness of this compressor.

These improvements, while they did not affect the principal distinguishing features of the original machine, were nevertheless very substantial ones, relating especially to the air cylinder and its adjuncts, with especial reference to the more perfect solution of the problem of disposing of the heat developed during compression, the lubrication of the piston, and the reduction of the volume of clearance. The first of these improvements, it is there noticed, was effected in the new machines by surrounding the cylinder with a jacket in which cold water is kept circulating, the water jacket being so arranged that the water enters at the cylinder ends—which, being the points of maximum pressure, are the hottest—traverses the circumference, and finds its exit at the middle. The lubrication of the piston, and means for reducing the volume of clearance, are described as being effected by means of an ingenious valve mechanism, which takes the form of a taper straight-way cock, the projecting end of the valve stem being provided with a pulley and a belt connecting it with one twice its size on the main shaft. This valve has but one opening, which both receives and discharges. This opening, at each stroke of the compressor piston, revolves past that part of its casing to which the pipe supplying the lubricating material is connected. Thus it is filled, the further supply of lubricant is cut off, and at the completion of a half revolution it is emptied into pipes which convey it to the suction valves of the air cylinder. During the period of air admission this lubricating material is admitted to the cylinder, and there remains on the cylinder bottom until the return stroke commences, when it slowly rises before the advancing piston, moistening both piston and cylinder surfaces, and filling all the waste space between the piston face and the level of the outlet or delivery valves. By a system of connecting pipes between the delivery valves of the cylinder, the air receiver and the lubricator, a small quantity of the material supplied to the receiver may be used again and again. The operation of the controlling mechanism obviates all danger of flooding the cylinder, no matter in what position the compressor may stop.

A further improvement consists in a device to lift the delivery valves from their seats at the precise point of the stroke when the pressure in the cylinder becomes equal to that in the delivery pipes. This device is positive, and is operated by an eccentric on the main shaft. Thus an economy is effected in the saving of the extra power that would otherwise be required to lift the large valves upon which the compressed air in the delivery pipes and receiver acts.



IMPROVED AIR COMPRESSOR.

The engraving which accompanies this article shows the improved compressor upon a larger scale than our recent illustration, and renders the details more obvious. In one particular, we observe, Mr. Clayton has modified the mechanism of the compressor. In the earlier machines, as will be seen by consulting the illustrations accompanying our previous articles, the steam pistons communicated power to the compressing pistons by means of a crank and yoke, in which sliding journal boxes connected with the crank pins. In the machine here represented a connecting rod is employed.

The importance of this class of machines in many species of engineering work, notably for tunneling, is so well understood by our engineer readers, to require no comment here; and these machines so fully meet the requirements of practice that they have very justly been accorded the highest rank in the estimation of the profession.

These machines are manufactured by the Clayton Steam Pump Works, 14 and 16 Water street, Brooklyn, N. Y., who will furnish any further information.

A New Cereal.

The Kansas State Board of Agriculture calls attention, in a late report, to a new and highly interesting cereal that has made its appearance in Kansas and New Mexico. It is represented to be more nutritious than corn, rye or oats, and is known variously as "pampas grass," "rice corn" and "Egyptian corn." Its origin is somewhat doubtful, but the general supposition is that it has sprung from seed brought to the United States by the Mennonites of Southern Russia.

The following is a description of the new grain, of which we may add, if the half of what is said of it is true, it will prove to be of enormous value as a food product over vast areas of our Western country, which, from want of water, are now absolutely useless for purposes of agriculture:

The kernels grow in a tuft like that on the top of sorghum, each being somewhat smaller and rounder than a grain of wheat, and being enclosed in a "shuck" or independent capsule. The berry can be used generally like any other grain, either ground into flour or cracked like wheat, or whole like rice. The meal resembles that of Indian corn, and in color is intermediate between the yellow and white varieties. In its percentage of starch, dextrine, sugar, the heat and fat producing elements, chemical analysis shows it to compare favorably with Indian corn, wheat, rye and oats; and in its proportion of flesh-forming albuminoids, it surpasses the first named of these, and ranks with the latter. The percentage of cellulose, or non-nutritious wood fiber, is represented to be remarkably low. The stalk makes as good a fodder as corn, and a few acres will furnish a family with fuel for the winter—an important item in a treeless country.

But all these favorable qualities are surpassed by the surprising quality it possesses of resisting drought, which is attested by the testimony of numerous farmers and others who have observed its behavior in this respect. One remarkable example, which we reprint, with comments, from the New York *Shipping List*, will suffice for our purpose:

"Forty acres of turned over sod, which had not been

wet with rain for eight months, were planted with two or three grains, deposited with a seed-planter, something more than a foot apart. There was no rain for five weeks after planting, yet the corn germinated. After it was fairly started, the hot blasts from the *Llano Estacado* blew over it, but it grew right along, although grass and garden truck beside it were fairly burned up. It stood the rain equally well, and finally yielded sixty 60-pound bushels to the acre. It is, moreover, worm and grasshopper proof. The Board of Agriculture prints a mass of letters which place these facts beyond question, and their signficance is of the first importance. From New Mexico to the British line there are tens of thousands of square miles (500,000,000 of acres, according to reliable estimates), which, it has been held, nothing but an expensive system of artesian wells could reclaim to any better use than pasturage; and now comes this African plant to furnish food and fuel to this vast country, besides crops for export, the value of which it may yet be impossible to estimate."

Important Engineering Works in New York and Vicinity.

From a late issue of the *Engineering News* we glean the following interesting notes concerning the progress of certain important engineering works relating to the permanent improvement of New York harbor, which have been going on for some years under government auspices.

Lieut.-Col. John Newton, of the United States Corps of Engineers, is the officer in charge of the improvement of rivers and harbors in the States of New York (including the removal of obstructions at Hell Gate), New Jersey and Vermont. Capt. James Mercur is the resident engineer in charge of the work now in progress at Hell Gate, which consists of excavations under Flood Rock and the removal of broken rock from the reef at Hallet's Point. Work on this point is rapidly nearing completion, and will, when finished, give a depth of 26 feet near the shore, rapidly deepening toward the channel. Flood Rock consists of two gradually shelving rocks, located directly west of Hallet's Point, and north of Blackwell's Island.

An observer unacquainted with mining engineering, would have no conception of the magnitude and ultimate importance of this work, judging from appearance of surface operations. Work here was commenced by sinking a shaft near the center of the larger rock, and after reaching a depth of 68 feet from the top, or 57 feet below low water, drifts were opened. On December 31, 1876, work was suspended—the appropriation having been exhausted—and the mine flooded. It continued in this condition until July 8, 1878, when the pumps were started, and by the 14th all water had been removed. It was found that numerous seams had opened in the roof and side walls, and timbering was necessary to prevent caving.

As the two exposed portions of Flood Rock were of small area, insufficient to accommodate the needed machinery and buildings, all the broken rock which was taken out up to January 7, 1879, was used in extending the island, and was placed so as to serve a dike for deflecting the ebb tide from the Gridiron and middle reef, until they could be removed. The total number of cubic yards put in this islet is approximately 5,722, and its area above high water 2,600 square yards. The rock removed since January 7, 1879, has been dumped principally between the two mill rocks.

A short distance south of the center shaft is a smaller one, with steps leading to the bottom, and through which the air and water pipes are carried. The drifts extend nearly north and south, and east and west; the distance between the centers of those near the main shaft being 37½ feet, and between those further out, 25 feet. This difference is because larger columns are needed adjacent to the opening, to support the superincumbent mass of rock. The galleries are from 9 to 15 feet in width, and vary in hight, according to the conformation and depth of the upper rock. If it is solid, with few or no seams, the bottom of the river can be approached to within 8 or 10 feet; if, on the contrary, it is loose and seems composed of fragments, the thickness is sometimes 20 feet. Seven drills, worked by compressed air, are now at work extending the drifts, and at every 25 feet, cross sections are opened and pillars about 17 feet square are left. When the work has been extended as far as necessary, the dimensions of these pillars will be lessened as much as possible, and only enough rock left, as a roof, to support the water. There are now eight passages, north and south, or parallel to the current, the distance between the extreme points being about 347 feet. There are nine passages extending east and west, the distance being about 238 feet. The tracks are laid as required, and cars, drawn by mules, convey the broken rock to the hoisting machinery, located in the center shaft. The car is rolled upon a cage running in vertical shears and raised 81 feet, the empty car at the same time descending. By means of wheels running in circular grooves, the car is here inclined about 45°. The lower side is unhooked, and the rock falls into a chute extending over the center of a vessel moored to the dock. Only two men are required to handle the rock after it leaves the mine, one at the top of the hoist to unload, and another on the boat to shift. About 112 car loads are taken out daily.

The area of the mine at the present time is about two acres, and up to March 1, 1880, 16,728 cubic yards of material had been removed. The work commenced with from 4,000 to 4,500 cubic yards per month, but is now more than doubled. Near the shaft is a comfortable stable, with four stalls and a feed-room, for the use of the mules, who will not see daylight until the work is finished. As water is continually dripping from the roof, it is necessary for the men to wear rubber or oiled clothing, and a large drying-room, heated by steam, is provided for their use. It was necessary, in constructing these buildings, to use the same precautions against water as are needed above ground—the roofs are inclined and the sides overlapped or battened. The mine is well ventilated, and owes its purity in a great measure to the work of the drills, which are constantly supplying fresh air. A large Worthington pump is placed near the smaller shaft, to keep the works as free from water as possible. It may be well to state in this connection, that the principal danger incurred is at the time of blasting—late in the afternoon. If, in opening a new portion, a rock should be found "keyed the wrong way," a flooding would be the consequence. Even should this occur, no harm is anticipated to the men, as the work is extended with great care, and but a small distance opened at each blasting. In an event of this description, work would cease until the opening could be filled from above.

There are three boilers, of dimensions of 6 × 28 feet, with two flues to each, 22 inches in diameter. Salt water is used altogether, and by means of surface condensers, water enters the boilers heated to from 150° to 200°. A dock was built just in front of the boiler-house, for the unloading of coal, which is carried by chutes directly to the fires. The hoisting engine is double, cylinder measurements being 17 × 24 inches, and the drum 8 feet in diameter. The ropes are wound around this in contrary directions, so that the two sets of lifting machinery are balanced, and the only work required of the engine is to lift the load—about one ton. The throttle valves, brake and reversing levers are so arranged that the engineer can control all, without moving from his position. A speaking-tube extends from this room to the bottom of the mine, and bell wires to the top and bottom of the hoisting frame. Directly in front of the engineer are two perpendicular shears, in which run two weights, raised and lowered by strings, which represent the main ropes, wound upon the shaft of the drum. This ingenious device enables the engineer to ascertain at any moment the exact position of the cars. There are five of Burleigh's air compressors for running the drills, three being worked all the time. The further plant consists of lathe, drill press, planer, pump, the requisite tools for making and repairing drills, emery wheels, and many special tools. In the blacksmith shop it was learned that American steel gives better results than foreign, the drills working from 3 to 4 feet without sharpening, according to the nature of the rock. Upon the extreme end of the northern part of the island is the building containing the explosives.

The time when the work will be finished cannot be ascertained, owing to the uncertainty of the appropriations. There are now under Captain Mercur's orders about 130 men. Work progresses night and day, except on Sunday, the men working in gangs on 8-hour shifts.

For the convenience of engineers unacquainted with New York, and who are desirous of visiting these works, we point out the most convenient route thereto. The Harlem River boats, from the foot of Fulton street or Peck Slip, land at Astoria, and during the summer are much more pleasant than the steamers of other routes. Another quick and pleasant way is to take the Third Avenue Elevated road to 89th street, walk to the foot of 92d street, and cross in the ferry to Astoria. Captain Mercur's (from whom permission can be obtained to visit the works) office is about a quarter of a mile north of the ferry. A large propeller—part of the permanent plant—plies between this point and the island.

A New Preservative Agent.

The announcement was widely published some months ago that a German naturalist, Herr Wickerscheimer, Conservator of the Museum of the University of Berlin, had succeeded in inventing a fluid for preserving animal and vegetable substances and tissues, which surpassed anything that had been hitherto known and used for that purpose. The genuineness of this invention now appears to be well established, from the following facts. Herr Wickerscheimer, it appears, had offered his invention to the Prussian government for a reasonable compensation. The offer was conditionally accepted, and a commission of experts was appointed to examine the fluid and test its qualities and effects. The results of this commission's examination have now been published by the State Secretary of the Department of Public Instruction, in the official *Staatsanzeiger*, and are there pronounced to have been very satisfactory. The government, in accepting the offer to purchase the invention of Herr Wickerscheimer, has likewise made it public property by publishing the formula for the preparation of the preservative fluid, together with a detailed description of the methods of using it. We omit the latter, since they would take up too much of our space, and even consist of only such methods of procedure as would suggest themselves to any person using it, and simply reproduce the recipe for the information of our readers:

In 3,000 grammes of boiling water, dissolve

Alum	100 grammes.
Common salt	25 "
Saltpeter	12 "
Potash (carbonate of potassa ?)	60 "
Arsenious acid	10 "

After cooling and filtering, add to every 10 liters of the solution 4 liters of glycerine, and 1 liter of methylic alcohol.

Iron and Steel Manufactories.—The following is a statement of the number and capacity of the iron and steel manufactories of the country at the present time: Number of completed blast furnaces March 1, 1880, 697; number building, 44; annual capacity of completed furnaces, in pig iron, net tons, 6,500,000; number of completed rolling-mills and steel works, 382; number building, 10; number of single puddling furnaces, 4,467; number of heating furnaces, 2,419; number of trains of rolls, 1,397; annual capacity of rolling-mills, in finished iron, net tons, 4,000,000; annual capacity of rail mills, in heavy rails, net tons, 2,150,000.

Files and File Manufacture.

FILE TEETH.

Rasp teeth are isolated, and are struck up with a punch. File teeth are either parallel ridges or regularly arranged lozenges made by the intersection of parallel ridges; in either case they are made by a chisel. Each size has various grades of coarseness, designated as rough, coarse, bastard, second cut, smooth, and dead smooth. What would be called "bastard" in one size file would be of a coarseness called "second cut" on a larger size. The softer the metal the coarser the teeth usually required. The "single cut," having parallel ridges, is less easily worn out than the "double cut"; hence used for rougher work—as saw filing. The second (crossing) series of chisel cuts, or up-cut, is generally finer than the first series, or "over- cut."

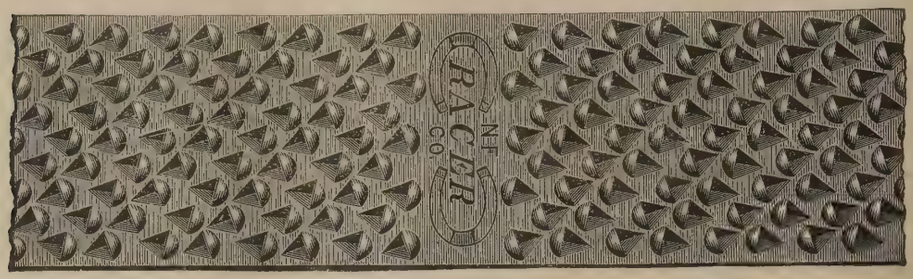


Fig. 1.—Rasp.

Rasps are used coarse by horse-shoers, bastard by carriage-makers and wheelwrights, and smooth by cabinet makers. The teeth should be set "staggering," and pointing in varying directions, thus freeing better and giving no side lead. (See Fig. 1). Lead and pewter require a very open single (or "float") cut to prevent clogging, and little obliquity of chisel cuts, to guide easily, (Fig. 2).

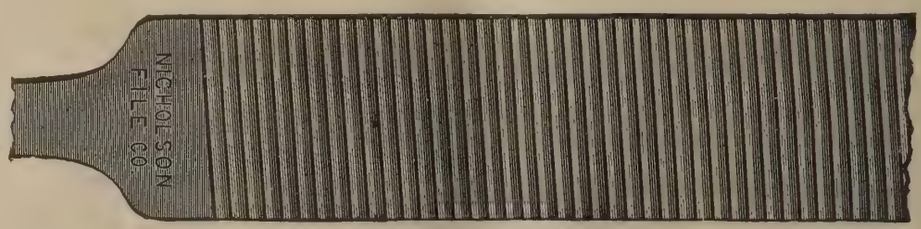


Fig. 2.—Lead.

Rapid rough work in brass and wood demands a specially coarse double-cut, (Fig. 3).

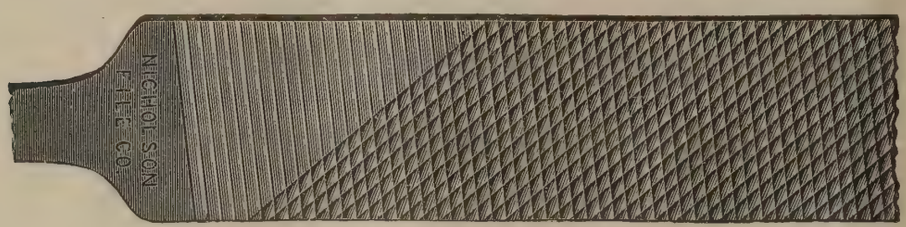


Fig. 3.—Brass Coarse.

For finishing brass and copper a special bastard double-cut is made, having open and very oblique over-cut and fine straight up-cut, (Fig. 4).

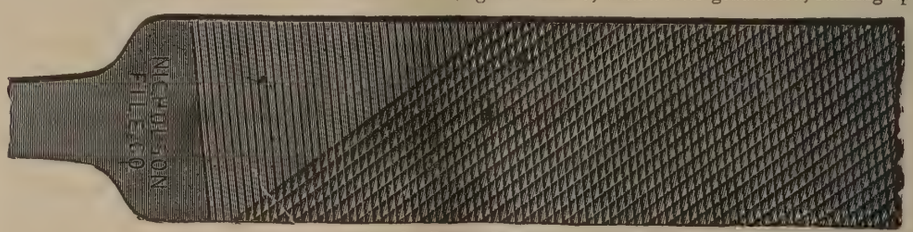


Fig. 4.—Brass Bastard.

For finishing steel or iron, the over-cut should be fine and straight, and the up-cut comparatively coarse, and inclined, (Fig. 5).

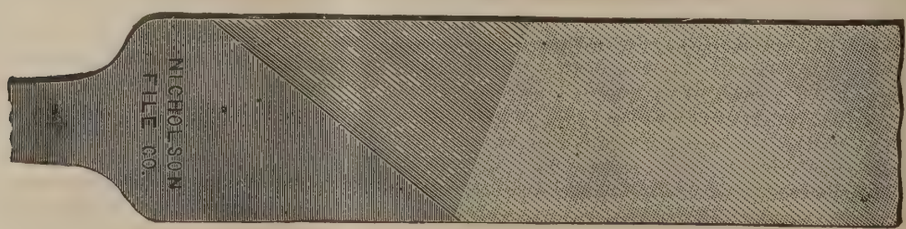


Fig. 5.—Finishing.

Regular tooth spacing is highly disadvantageous, hence the demerit of most machine-cut files in comparison with hand-cut. The Nicholson Co. spaces them gradually wide apart from point to the middle, and thence more closely to the heel, and also slightly varies the horizontal angle of the cuts across the file face. Such arrangement of teeth cannot be too strongly insisted upon, as it causes greedy but easy cutting, and while enabling the filer to remove a great deal of stock, leaves the cut free from furrows or shallow places.

In reference to this regular tooth shaping, we find the "increment" principle applied by advanced tool makers in almost every department. Saw-makers, for instance, find that a rip saw requires a finer point at the teeth than at the heel to prevent splintering and let the tool get good hold of its work before the rough work comes in. Mill saws are sometimes thus made; and circular saws having variably spaced teeth are said to cut easier and smoother than others. Tap and reamer makers not only try to have an odd number of flutes, but sometimes purposely space them variably; and in twist drills the success of the "increment twist" is unquestioned. This idea of regular or systematic irregularity seems to be a leading principle in other branches of industry and science, as we find increment pitched screw propellers giving increased duty, and preventing that "slip" or rotation of water column so wasteful of power when the "true screw" is used. In brick and other similar machines we find an "increment spiral" do more effective mixing and stronger forcing than where the pitch is regular. We might go on multiplying instances corroborative of the wisdom of the "increment spacing" principle, but as even the whole solar system is "increment spaced," we shall not attempt even exhausting the list by mere enumeration.

Another advanced idea in file making, introduced by the Nicholson File Co., is so arranging the teeth that the successive rows shall not be exactly parallel, but cut slightly angular with respect to each other, the angle of inclination being reversed (during the operation of cutting) as necessity requires. This gives a smooth *shearing cut*, especially desirable in metal cutting.

In concluding this short memorandum on file teeth, let us impress upon our readers the importance of choosing for each kind and size of work the cut and size of tools best calculated therefor.

Boiler-Plate Testing Machine.

The machine illustrated on the opposite page was designed and constructed for the use of the United States Steamboat Inspector's office, in the Post Office building, this city. It was especially designed to be used for testing the tensile strength of boiler plate, and has a capacity of testing up to 75,000 pounds.

The machine may be described in a general way to be a very powerful and accurate weighing platform scale, the strain applied to the specimen to be tested representing the load to be weighed. This strain, produced by means of gearing to be hereafter described in detail, is accurately recorded on the scale beam. The accuracy of the apparatus can, therefore, be tested with standard weights, the same as with an ordinary platform scale. The construction and mode of operation of the machine will be understood from the following description: Commencing with the scale, the main beam A carries a poise B, which moves on rollers, and may be run out to indicate 75,000 pounds, while the lighter beam C, with a finer graduation, running up to 6,000 pounds, has a poise D which is moved automatically by clock-work E, attached to the end of the beam. The platform K is carried on four knife-edges in the main levers F, one at each corner of the scale, and the weight, or strain, is transmitted from these, through a system of connected levers G, H and J, shown in the engraving, to the steelyard rod, and thence to the scale beam A, where it is recorded, as above noted.

The mechanism for putting on the strain will next be described: Resting on the scale platform are seen two columns L, having a cross-head, from which is carried the upper clamp M for holding the test-piece. Beneath this appears another cross-head P, to which is secured the lower clamp N. By means of this lower cross-head, to which a vertical movement can be imparted by mechanism about to be described, the strain is brought to bear upon the test-piece V, which is securely held in the clamps M N by the interposed steel wedges W W. The straining mechanism consists of the two screws R R of the lower cross-head P, which

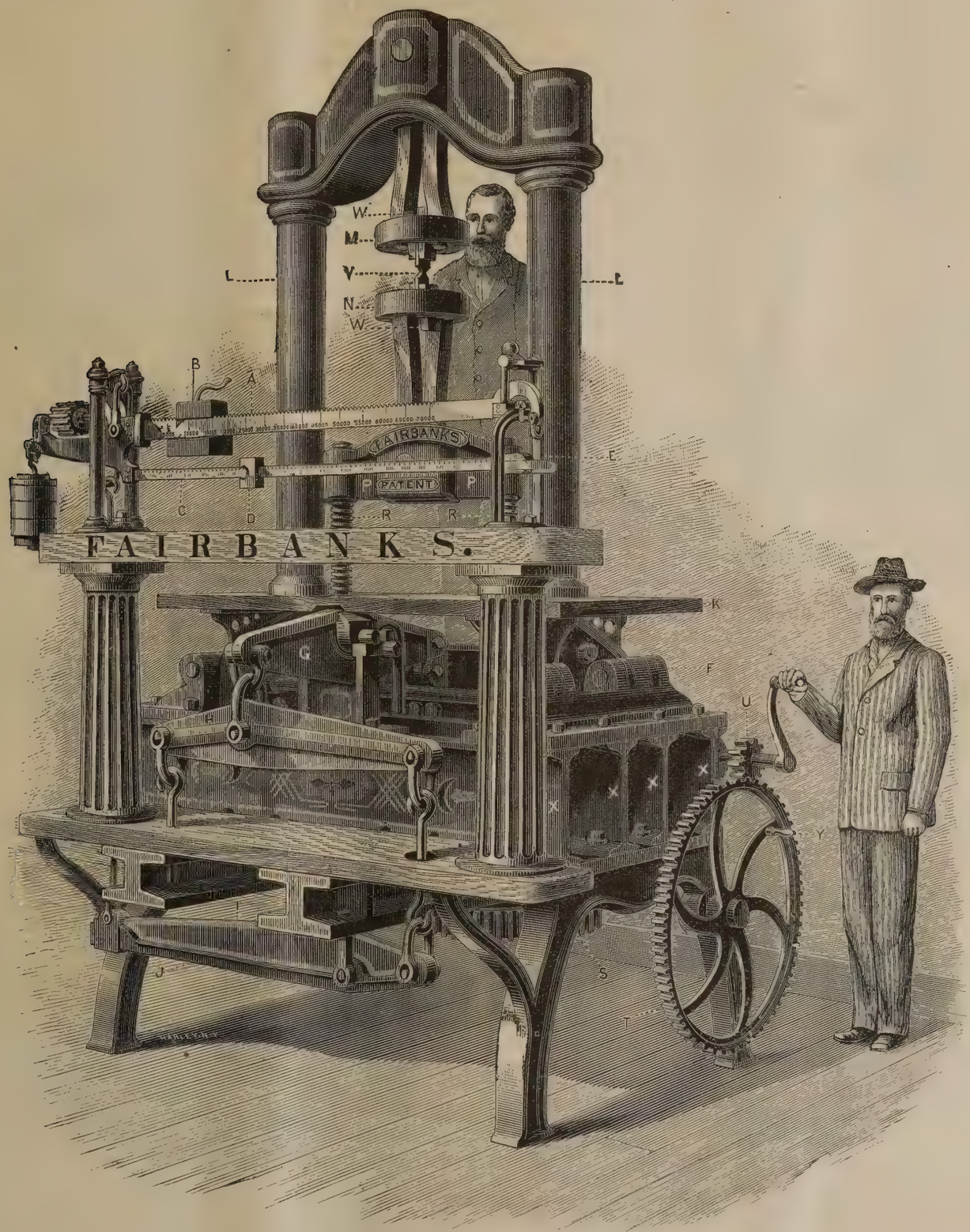
are moved up or down by worm-gears S S, which in turn are worked from worms on the shaft of gear wheel T. This last is actuated by hand through a small pinion U, which can be thrown in and out of gear as may be desired.

The process of making a test with the machine is as follows: Having secured the test piece V in the clamps M N, as above mentioned, the pinion U at the start is slipped out of gear, and the screws and gearing are turned by the handle Y of the large gear wheel, until the specimen is slightly strained. The pinion is then thrown into gear and the strain continuously increased through it. As the strain increases, the automatic poise D moves along the beam until it reaches a point equivalent to the strain on the specimen, when the beam drops, causing the poise to stop. By shifting the poise B, as will be required from time to time as the strain is increased, and until the test piece is broken, the exact number of pounds of strain at which rupture took place will be indicated on the beams by the position of the poises.

These machines are claimed to be very superior for their intended purpose; the mechanism permits a steady strain to be applied and maintained as long as may be desired, and, as remarked at the outset, their accuracy can be determined from time to time by actual tests with standard weights, as with any platform scale.

For special purposes of testing materials for construction, these machines are, while retaining the same general principles of action, modified in minor points to meet the requirements of each case. They have been used with gratifying success by government officials and private parties, and from a mass of ample testimony to their efficiency that has come into our hands, we deem it sufficient to notice the following appreciative criticisms from competent experts. The first is from Gen. James A. Dumont, Supervising Inspector-General of Steamboats, Treasury Department, Washington, D. C., who writes as follows:

"I was very much pleased with the construction and working of the machine set up in New York. I think it the best for its purpose I ever saw in operation. The pressure on the plate to be broken is so even and gradual, there is no possibility of its breaking before



BOILER-PLATE TESTING MACHINE.

the ultimate strength is reached, and when the break occurs, it is without jar or noise. The accuracy of the weighing qualities is admirable, and these are so delicately adjusted that it notes the smallest variation in weight. It is compact without sacrificing strength, and finely finished in all its parts. Altogether, I consider it a handsome piece of mechanism, eminently worth the attention of all persons interested in ascertaining the tensile strength of iron."

Dr. Charles Huston, of the firm of Huston, Penrose & Co., Coatesville, Pa., who has extensive iron mills, and takes some interest in securing accurate tests, writes: "I think the arrangement of a testing machine in the shape of a platform scale, that may be tested with standard weights to prove it accuracy, must strike any one very forcibly, particularly when the result of his test disappoints him. For instance, I cut several specimens from the same plate, and had one tested in Washington, which broke at 56,000 pounds; one in Coatesville broke at 60,000 pounds; one at Pittsburgh broke at 64,000 pounds; one tested by the new Fairbanks testing machine in the U. S. Steamboat Inspector's office, New York, broke at 55,000 pounds. A very wide difference, as you will see; and as the last named machine was the only one whose accuracy could be proved by actual tests with standard weights, I am obliged to conclude that it was the only accurate machine in the lot."

The makers of these testing machines are Messrs. E. & T. Fairbanks, 311 Broadway, New York.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

The Post estate propose rebuilding the "Post Building" on Hanover Square.

Ogden Goelet is to have a fine residence built on the corner of Fifty ninth street and Fifth avenue.

It is proposed enlarging Steinway Hall, which has been found inadequate to hold the audiences at some of the recent concerts.

The site of the building lately destroyed by fire on Twenty-ninth street, corner of Seventh avenue, is being cleared and a factory is to be built for occupation by the Domestic Sewing Machine Company.

At the southeast corner of Fifty-fourth street and Fifth avenue a brick and brown-stone dwelling, four stories high, with Mansard roof, is nearly ready for occupancy. It is owned by Griffith Rowe.

On the east side of Fifth avenue, between Forty-seven and Forty-eighth streets, George Opdyke has nearly completed a brown-stone dwelling, 30 feet by 67 feet, and four stories high, to cost about $55,000.

H. M. Congdon has drawn the plans for an addition to the St. Mary's Free Hospital for Children, 407 Thirty-fourth street. It will be of brick, with stone finish, and will cost about $40,000. Jeans & Taylor are the contractors.

Robert Goelet is to build a house on the corner of Forty-eighth street and Fifth avenue. It will be very elaborate in construction and finish, the front of brown-stone, and will cost about $225,000. The size is 100 by 50 feet. E. H. Kendall is the architect.

C. L. Cornish, builder, is finishing eight brown-stone houses on the northside of Sixty-fourth street, between Fourth and Madison avenues, having a frontage ranging from 12.6 to 18 feet. The stoops, rails, balusters are all of brown-stone, the various stories are double floored.

Excavations have commenced on the lot, corner of Park avenue and Forty-first street, for the foundation of the Manhattan Island Eye and Ear Hospital. The building will be 98.9 by 70 feet, of brick and stone. The style is to be Jacobean. Cost, $100,000. Charles C. Haight is the architect.

The plans for a factory to be erected at the corner of Duane and Hudson streets have been completed by S. D. Hatch. The building will be 101'3" by 78'7", of brick, with granite and Wyoming stone finish, and will cost $150,000. J. H. Masterton will do the mason work; Jno. Sniffin is the carpenter and Leopold Schepp the owner.

The house of C. Vanderbilt, at the northwest corner of Fifth avenue and Fifty-seventh street, a description of which has already appeared in these columns, is built up to the second story. The basement is of granite and the upper walls brick and limestone. The dimensions are 48 feet front, 100 feet rear, 125 feet deep, and five stories high. It will cost $750,000.

At No. 374 Fifth avenue, between Thirty-fifth and Thirty-sixth streets, a handsome dwelling is nearly completed, built by the trustees of William Astor, and costing about $70,000. Its dimensions are thirty-seven feet front by eighty feet deep, and contains five stories, basement and sub-cellar. The front is of Philadelphia brick and rough brown-stone. It contains two stairways, an elevator and a hot air furnace. An ornamental roof completes the structure.

The new residence of George Kemp, at the northwest corner of Fifth avenue and Fifty-sixth street is one of the most striking dwellings in the city. It is a double house, 50 feet front and 85 feet deep, five stories high, and is surmounted by a mansard roof, flanked with ornamental towers. The material is Haverstraw brick with stone trimmings. Workmen are now engaged in fitting up the inside, in which ornamental wood-carving will form an important part.

The new building of the Union League Club at the northeast corner of Thirty-ninth street and Fifth avenue is completed to the fifth story and one more story is to be added with a mansard roof. The width will be 84 feet, and the depth 152 feet. The materials are Philadelphia brick and Longmeadow brown-stone, with granite base. The entrance, flanked by massive brown pillars, is on the Thirty-ninth street side, leaving an unbroken line of large windows in the Fifth avenue front. The cost will be about $350,000.

In our February number we made mention of the fact that the Eighth avenue Railroad Co. had made preparations for the erection of a car stable on the site of the one burned several months ago (west side of Eighth avenue, extending from 49th to 50th streets). Plans of the building have recently been filed in the Department of Buildings, and from these we learn that the new stable is to be of brick, three stories high, and is to have gravel roof and brick cornices. The builder is John Correga, and the estimated cost of the building is $125,000.

Negotiations have been on foot for several months past to secure ground for the extension of the New York Stock Exchange. The obstacles which stood in the way of securing a perfect title to the ground have at length been removed, and the purchase has been completed. Three lots on New street—Nos. 12, 14 and 16, adjoining the rear of the Exchange—and No. 14 Broad street, were transferred by Alexander Hamilton and executors to the New York Stock Exchange Building Company for $375,000. The plans for the new building have not been decided upon, but will probably be considered immediately.

Miscellaneous.

An opera house is to be built at Milford, Mass.

Robert Chase & Co. are rebuilding their mill at Northumberland, Pa.

A new town hall is being erected in Leamington, Canada.

G. M. Pullman has ordered plans to be drawn for a cottage to be erected at Long Branch; cost, $50,000.

An opera house is to be built at Mansfield, O.; estimated cost, $40,000. The architect is D. W. Gibbs, Toledo, O.

The Central R. R. Co. are to build on Exchange street, Buffalo, N. Y., a building to contain dining-rooms, baggage-room, offices, etc.; cost, $100,000.

Wm. A. Harris, of Providence, R. I., will make an addition to his works at the corner of Park and Promenade streets, a foundry, 110 by 160 feet, and a wing 130 by 161 feet.

A station for the Concord Railroad is to be built at Nashua, N. H. It will be of brick and will measure 40 by 63 feet.

A brick school-house is being built at New Britain, Conn. It will be three stories high, and 93 by 51 feet; cost $10,000.

The congregation of B'nai Jacob, Detroit, Mich., has decided to build a synagogue, and has appointed a committee to procure a suitable site.

A stock exchange, costing $50,000, is to be built in Baltimore, Md. The exact plans and site of the new structure have not been decided on.

A hall estimated to cost $60,000 is to be built for the Saengerfest at Detroit, Mich. It will be ready for occupancy by the 15th of August next.

Tuttle & Whittemore are building a foundry at Naugatuck, Conn. The material is brick, and the dimensions of the building are 250 by 40 feet.

A. S. Barnes & Co. are erecting in Brooklyn, at Nassau and Liberty streets on the former site of the First Baptist Church, a six-story publishing house.

W. H. English is to build on the Governor's Circle, Indianapolis, Ind., a fine opera house which will seat 3,000 persons. The architect is not yet appointed.

Chas. D. Carson, architect, of Baltimore, is preparing drawings for a new three-story Masonic Hall, to be erected at Easton, Md. It is to 40 by 40 feet, and will cost $8,000.

H. M. Congdon of New York is drawing plans for Christ Church which is to be built at Portsmouth, N. H., at a cost of $40,000 from a bequest of the late Mr. Marsh. It will be of stone, in Gothic style.

Gargen & Co. have just broken ground in Danbury, Conn., for a hat shop, 26 by 130, three stories; one shop, 40 by 60, two stories; one shop, 20 by 50, two stories; one shop, 20 by 60. W. W. Sunderland, architect.

There are over one hundred houses of different kinds now building in Bridgeport, Conn. P. T. Barnum has instructed his agent in that city to build one hundred houses on property he owns, and already some fifteen or twenty of them are under way,

Beckerly & Co. of Danbury, Conn., are building six three-story frame hat factories, at that place—one shop 140 by 30, one shop 90 by 30, one shop 60 by 30, one shop 90 by 26, one shop 44 by 50, and one shop 20 by 50. Cost, $20,000. Foster Bros. architects.

An Industrial Home for Blind Women is being erected at Powelton and Saunders avenues, West Philadelphia, Pa. It will measure 50 by 120 feet, and will be three stories in hight. The first story will be built of stone, and the two remaining stories of brick. Cost, $29,000.

J. H. Besarick of Boston is the architect of a family hotel to be built on the corner of Battle and Spark sts, Cambridge, Mass. It will form part of a scheme of five similar buildings enclosing a park. The hotel will be of brick, four stories high and will measure 46 by 58 feet.

The sum of $1,500,000 has been appropriated to complete the new Capitol building at Albany, N. Y. Owing to the cracks in the sandstone lining, the lavish use of which has been both questioned and condemned, this material is not to be so extensively used in the southeast pavilion.

Drawings for the new five-story warehouse for the Johns Hopkins's Estate, which is to built on Sharp street, between German and Lombard streets, Baltimore, Md., are nearly completed. This building will measure 45 by 75 feet. The fronts will be of brick, with stone and terra-cotta finish. Cost, $60,000. Dixon & Carson are the architects.

A church is to built in Boston, Mass., by the "People's Church" congregation on Columbus avenue, near Berkeley. The materials for the exterior will be Roxbury stone and buff freestone. The auditorium, with the connecting chapel, will accommodate about 3,000. The building will measure 100 by 120 feet. The cost of the building is to be about $50,000. J. H. Besarick is the architect.

Tweddell's System of Hydraulic Riveting.

Riveting by power was first accomplished by machines in which the riveting die was actuated by means of a crank, cam, or toggle-joint movement, which moved it back and forth a fixed distance. The work done by machines of this class was not of necessity uniform, for the reason that rivets of varying length and diameter, driven into holes of varying diameters with a uniform amount of compressive motion, sometimes failed to fill the space for want of metal, and sometimes overstrained the joints from excess of metal.

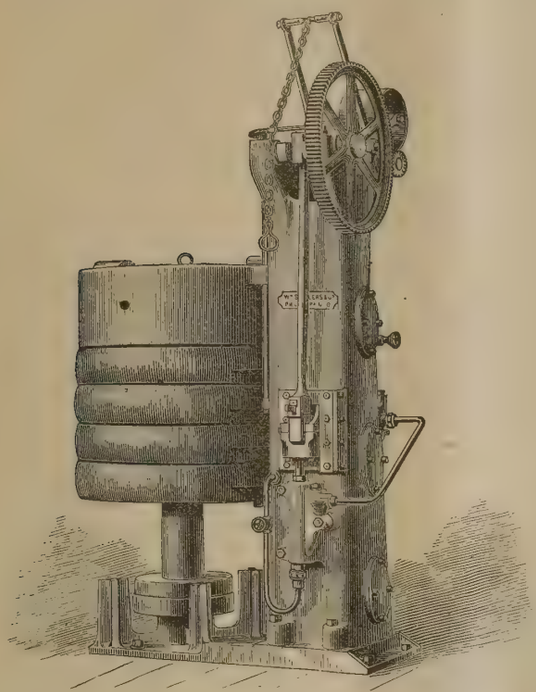


Fig. 1.—Pump and Accumulator.

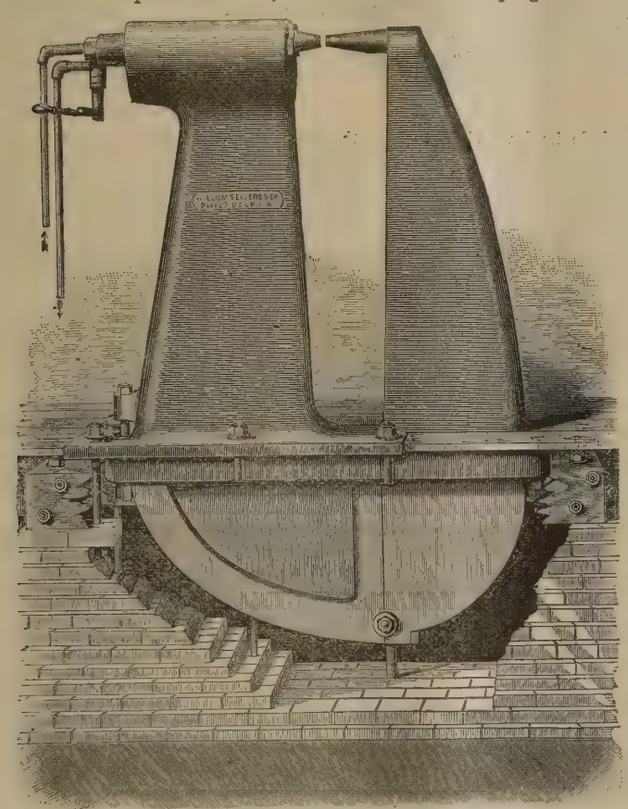


Fig. 2.—Stationary Riveting Machine.

In comparison with other systems, hydraulic riveting machines, properly arranged, afford special advantages for the reasons that they give a uniform pressure, free from shock, forcing the metal to flow into the holes and to fill them perfectly, and insure within reasonable limits the same pressure on each rivet regardless of the size or length of the rivet or the diameter of the hole into which it is to be forced.

The system of hydraulic riveting devised by Mr. Ralph H. Tweddell, of Westminster, S. W. London, and which has been extensively introduced abroad, is affirmed to combine all the advantages and to avoid the difficulties incidental to the machine systems heretofore used. The system of Mr. Tweddell has been introduced into this country by Messrs. William Sellers & Co., of Philadelphia, who have modified it to some extent to adapt it to American requirements.

Mr. Tweddell's machines are made either portable or stationary, and he has contrived many ingenious arrangements to adapt them to the various kinds of rivet-driving. The important feature of this system consists in the use of a hydraulic pump and an accumulator, in which the water is stored under pressure, the accumulator being provided with detachable weights, so that the load on the plunger may be adjusted to any desired pressure per square inch. In driving a large or small rivet, therefore, the pressure can be set, by adjusting the load on the accumulator to what has been demonstrated to do the work well, and without straining the sheets, and the utmost uniformity in riveted work is insured. The pump and accumulator are shown in Fig. 1. They may be connected by hydraulic pipes to either stationary or portable machines. The pump is double-acting, actuated by crank motion. It takes its water from a reservoir in the upright, into which the return water re-enters after filtration through a mass of sponge. The water on its passage from the pump to the accumulator passes through a relief valve on the back of the upright, which is so devised as to relieve the pump from strain when it is not required to do work, but which maintains a uniform motion of the pump. This valve is controlled by the motion of the accumulator; when this is full the valve is open, and the water under pressure in it is shut off from the pump, which, being relieved from strain, draws water from the reservoir and forces it back again into the same reservoir; when the accumulator has descended a short distance, the relief valve is closed and the pump forces its water directly into the accumulator. Thus the stoppage of the pump each time the accumulator fills, or the discharge of the surplus water under a safety valve, (both of which alternatives are objectionable), are both avoided, and the pump, relieved from strain when no work is being done, is ready for immediate service.

To adjust the pressure, as above stated, to the work being done, the weights of the accumulator are suspended below the main casting in such a manner as to be readily released from it. Each of these weights represents a pressure of 250 pounds per square inch on the ram of the riveting machine. When all the weights are on, a maximum pressure of 2,000 pounds is obtained, and between this figure and 1,000 pounds the pressure can be varied by increments or decrements of 250 pounds.

For comparison, we may state that stationary hydraulic riveters (Fig. 2), with cylinders of 6¼ inches diameter, and using water under a pressure of 2,000 pounds per square inch, will do the work of a steam riveter with 36-inch cylinder, using 60 pounds of steam.

The wonderful convenience of the hydraulic system is best illustrated in the construction and applications of the portable machines, of which we give two views, (Figs. 3 and 4), showing their application to seams in any position. The shape of the riveting jaws or levers is shown in Fig. 3. The dies are carried by levers of the third order, so proportioned that the die pressure is two-thirds of the cylinder pressure. The portable hydraulic riveter is suspended from a hoisting machine on an overhead carriage, having a longitudinal motion on an overhead rail of about 50 feet, and a transverse

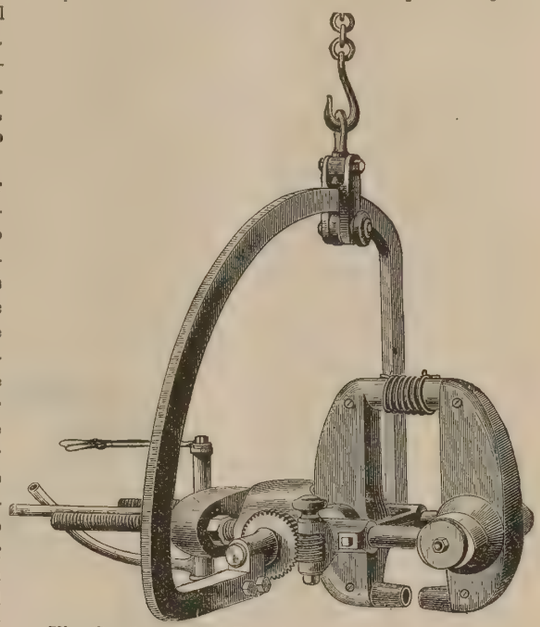


Fig. 3.—Suspended Riveting Machine—Side View.

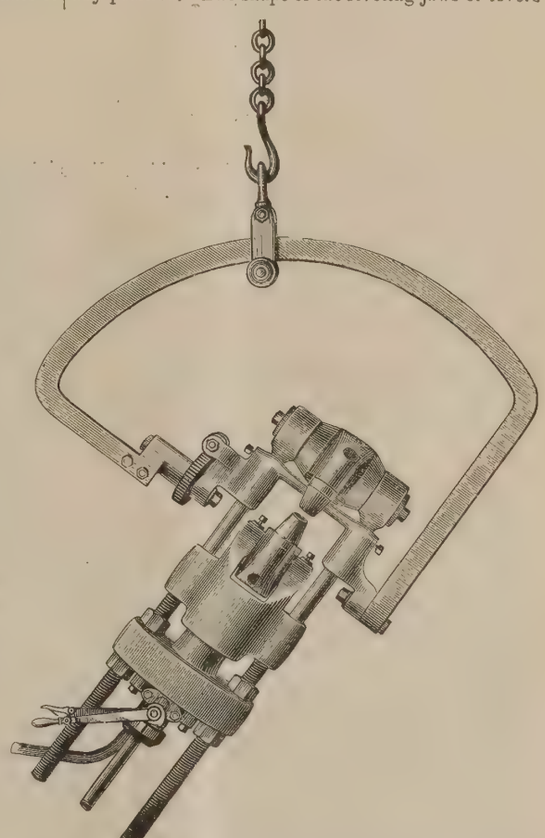


Fig. 4.—Suspended Riveting Machine—Bottom View.

motion of 6 feet, thus permitting of the use of the machine at any point within a space 50 feet long by 6 feet wide. In this space the work rests on trestles, and the riveting machine is moved along or around it. One man raises or lowers the riveter, adjusts it to the rivets, and closes the dies by a motion of the valve lever, while boys drop the red-hot rivets into place. On beam work, from 10 to 16 rivets can be driven per minute. For boiler work, the stationary machine is used, and the work is presented to it suspended from a crane.

Respecting the convenience and economy of this system, it may be interesting to note the following comparative statements: On boiler-work the same number of men form a gang to drive one rivet at a time as are required to run the hydraulic machine and the hoisting apparatus; but while hand-riveting is a trade of itself, the hydraulic machine does not require skilled riveters. The necessity of holding the rivet in boiler-work until it is cool, limits the operator to 5 rivets per minute; without this restriction the rapidity of the work could be vastly increased. But, taking everything into consideration, the claim is made that the comparison between machine and hand riveting in the same shop, is ten to one in favor of machine work. On girder-work the difference in favor of machine work is even more marked, as many as 5,000 rivets in ten hours having been driven by one gang with one portable hydraulic riveter. As to the efficiency of power as compared with hand-riveting, it is claimed, as the result of many experimental tests, that while the hand-driven rivet fills the hole very well immediately under the head formed by the hammer, it is impossible to transmit a sufficient pressure by this means far enough to affect the metal some distance from the head, on which account it is found necessary, in hand-riveting, to use shorter rivets than it is possible to work with the machine. From this fact, the conclusion is drawn that the heads of machine rivets being larger and stronger, will hold the plates together more securely than the smaller hand-riveted head, which last is rendered necessary because of the impossibility of effectively working with hammers as large a mass of metal as can be worked with the machine.

The engravings illustrating this article we have from Messrs. William Sellers & Co., of Philadelphia, who control the invention of Mr. Tweddell in this country.

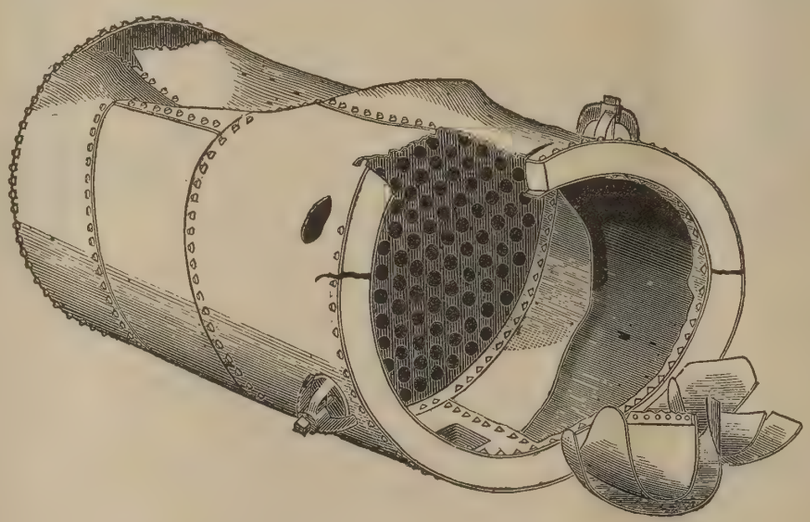
Etching on Copper.

M. Leon Vida writes to the *Photographic News* as follows: "My attention has lately been drawn to a new process for the production of line or stippled drawings, and as it seems to me to be worthy of notice, I give a short description of it. A copper plate is first coated with bitumen on the turning table, in the same way as in photo-zincography, and when the bitumen is quite dry an impression from a lithographic stone on transfer paper is applied to it; when this paper is removed, we have a copy of the impression in fatty ink on the bitumen surface. This surface is then dusted with fine bronze powder, which adheres to the inked portions, and renders them quite opaque. If, now, the surface be exposed to the light, the bitumen not covered by the powder will be rendered insoluble; on the plate being placed in some solution which dissolves the bitumen, the copper will be laid bare in the parts not acted on by light. These parts can then be etched in by a concentrated solution of iron perchloride, and when the depressions are sufficiently marked, the action of the mordant is arrested, and all the undissolved bitumen is removed. We have in the end an intaglio engraved plate. This process is very well adapted for line or stippled drawings, but it will not answer for the production of those with half tones."

Contributions to the Origin of Steam Boiler Explosions.

We avail ourselves again of the opportunity of gleaning from the carefully collected and well digested mass of fresh material relating to this subject, which the industry and scientific zeal of the Hartford Steam Boiler Inspection and Insurance Co. continue to place before the steam using public.

There can be no question that the accumulation of facts respecting the details of many explosions of steam boilers, derived from the personal examination of experts, competent by reason of special study and long experience in such matters to correctly analyze the circumstances of each case, and to properly interpret the facts attending each, must ultimately be of great service both to science and to humanity. For only in this way is it possible to positively identify and classify



the causes of such disasters; to exclude irrelevant hypotheses, and from the reliable data thus collated to finally formulate the laws and conditions that must govern the element of safety in the use of steam. The contributions which the Hartford company have been making for a number of years to the rational investigation of this vital subject to steam users, have been of conspicuous value, and are worthy of all the recognition they have received at home and abroad, the more so from the fact that the doings of private corporations so rarely rise beyond the dead level of money getting. From the monthly record of cases noticed in the monthly bulletin of the Hartford company, we select the following case of an upright boiler, which is reported to have exploded with astonishing force during the latter part of the past year.

The following are the details of its construction: The boiler was 7 feet high by 42 inches diameter, and contained 70 tubes of 2 inches diameter; shell was of $^{5}/_{16}$ and furnace sides of $\frac{1}{4}$ inch iron plates; the tube plates were $\frac{5}{8}$-inch thick.

The boiler had been inspected by the State Inspector, and a certificate issued allowing 70 pounds of steam pressure to be used. The safety valve was loaded to blow off at 65 pounds, the usual working pressure being 60 pounds. The watchman was instructed to start a fire about half-past six, and to have not more than 40 pounds of steam on at 7 A. M., when the engineer was to arrive. Several parties assert that steam had been blowing off from the safety valve for nearly an hour previous to the explosion, which occurred about 6 A. M. The pressure at the time of the explosion could not be ascertained. The effects of the explosion were terrific; the engine house and boiler house were completely demolished, the ground being literally cleared, and the boiler was thrown a distance of over 300 yards.

An examination of the exploded boiler showed that the furnace had collapsed, and was stripped in a very peculiar manner into several small pieces. The furnace plates were somewhat reduced by corrosion, and grooving was detected on their water surfaces near the base ring, caused by the slight motion of the plates of the furnace from the varying internal pressure, there being no stay bolts to resist the motions. Nothing was discovered to indicate negligence on the part of the engineer, or of the owners. The small pieces stripped from the furnace plates are shown in the foreground of the engraving. The thinning by corrosion is at the upper narrow ends of the pieces as they were placed for the purpose of being included in the photograph from which the engraving was made. The crushing and fracture of the base ring and shell plates were caused by the fall of the boiler from the immense hight to which it was thrown by the explosion.

The inspector of the company draws from his observations of the facts attending this explosion, the following hypothesis as to its cause: He holds that it is a case of a gradually increasing pressure to an extent greater than the boiler was able to resist; that the furnace, being thin iron and unstayed, was the weakest part of the structure. Deterioration commenced here on the water surfaces, and progressed, at first very slowly, but as the plates became weaker from corrosion, the motions from the varying pressure became greater as the resistance became less, and the chemical action of the water upon the fibers of the iron that were laid bare and separated by the mechanical action of bending and strains wore away the metal along the weak lines at an increasing rate, until it gave way, and the plates were pressed into the cavity of the furnace and torn into a number of pieces; the reaction of the expanding contents of the boiler threw it into the air, as a rocket is projected when the fire reaches the chemical compound within it.

Commenting upon this explanation offered by the inspector, the bulletin of the company appends the following practical remarks: "It may be questioned whether the astonishing phenomena attending this accident are satisfactorily accounted for by the propositions of the hypothesis. For it is often said by intelligent observers, in speaking of this kind of accidents, that to produce such results the pressure must have been something enormous, and the boiler a strong one to have resisted it till a sufficient force was stored to do the work. Now, while it is not claimed that the propositions are, to the perception of the average boiler owner, axioms in engineering, still it is believed that they may be supported by common sense arguments. It is unfortunate that the data necessary to make a mathematical calculation are so far wanting in this case as to preclude the possibility of making a clear statement of the capabilities of the forces which were stored within this boiler at the moment of the collapse of the furnace. It would be necessary to know (*a*) the pressure and weight of steam and water in the boiler, (*b*) the weight of the boiler itself, (*c*) the area and frictional character of the opening through which the water and steam reacted on bodies exterior to the boiler, and (*d*) the direction of the flight.

"It is believed that a pressure of steam not greater than that required by law to be applied in testing (105 pounds in this case) would be quite sufficient to produce the effect, while it is possible that the pressure that broke the boiler was considerably under that figure, for the deterioration may have progressed very rapidly toward the last, while working at about 60 pounds, until its strength was so far reduced that the maximum pressure allowed by the State Inspector, or that at which the valve would entirely take away the

steam produced by a vigorous fire, was sufficient to collapse the furnace.

"The extremes of the motions occur as often as steam is raised from zero to the working tension, while a great number of minor motions occur as the steam pressure varies during the working of the engine. The furnace, being at last broken along the weak lines caused by the buckling of the plates, a large opening is quickly made, the stronger parts that have not been affected so much by the buckling are then taken at a disadvantage, and the stored up force within the boiler now sets the water in motion to complete the secondary work.

"For the purpose of considering the case more specifically, suppose the pressure at the moment of the rupture was 80 pounds to the square inch, and that the boiler contained 2,000 pounds of unevaporated water and 2.5 pounds of water in the form of free steam in the steam space above the water. The sensible temperature of the whole contents of the boiler approximately 324° Fah. The weight of the boiler 2,500 pounds, and the area of the annular opening being $3'' \times 9'$, a little more than 2 square feet, and that this opening was the narrowest part of the channel through which the water and steam passed from the boiler. These data are introduced for illustration, without pretension to accuracy. The pressure assumed corresponds nearly to that of 180 feet of vertical water column, and its initial velocity, issuing through a favorable opening, is about 100 feet per second. The calculation would not be very difficult if this force acted within a cylinder upon a movable piston; but only the first gush of water, which is guided by the sides of the boiler, acting against the floor of the furnace and the bottom of the ash-pit, can be said to be in any degree parallel to the simple form of cylinder and movable piston. It is, however, something like a movable cylinder and a stationary piston, and the boiler gets a pretty strong initial impulse. A calculation of the capability of the stored up force within this boiler gives us millions of foot-pounds, and, if applied to a steam engine, would actuate one of thousands of horse-power during the second of time that the force was at work upon the projection of the boiler."

The Commercial Aspects of the Canal Across the American Isthmus.

A recent number of *Harper's* contains a very interesting *resumé* of the probable value of the American canal to the commerce of the world, from the pen of Mr. E. H. Derby. The views of Mr. Derby, as expressed in his estimates of the traffic which he believes the canal would be able to command, would, if realized, give it the control of the bulk of the traffic of the world. As compared with that of the American canal, the traffic of the Suez, on Mr. Derby's estimates, sinks into comparative insignificance. We present his views in the following paragraphs, with the single comment that though they may be somewhat rose-colored, they seem to us to be substantially correct, and serve the purpose of an additional argument in favor of the construction of a work in which the whole commercial world is interested. We want to see the problem of the strait solved, and whether it shall be solved by canal or railway, the question of who builds it is of secondary importance. At the present moment, matters relating to the canal remain in *status quo*; M. de Lesseps has returned to France, presumably to consult with his colleagues and associates as to their future course of action, which will most probably be somewhat modified by reason of the outspoken opposition which his project has aroused in this country, and which was doubtless more pronounced than he had expected to find. Capital is exceedingly shy, and in spite of Lesseps' well demonstrated ability to carry large undertakings to a successful conclusion in the face of serious obstacles, it is an open question, if the hostility of the press of this country, and the inimical official utterances from Washington, to which we referred in our last, have not made intending investors too timid to furnish the "sinews of war." Mr. Derby expresses himself as follows:

"The success of the Suez canal insures the construction of another ship canal, most important to the United States—one which will form a new route for its coastwise commerce, which now passes around Cape Horn to the Pacific. It will reduce a voyage of 18,000 miles to less than one-third of that distance, and diminish the time required on the way to one-fifth of the time now taken, replacing the vessel under sail with the steamship of steel. The Pacific railways are adapted to the transportation of mails, travelers, and express freight; they are important also for local traffic, but in no respect suited to our chief coasting trade—the conveyance of grain, provisions, timber, coal, fish, and metals between the Atlantic and Pacific. When a ship canal is finished, it will cheapen all our routes to the Pacific, and it is safe to predict that it will reduce the rates of freight between the Atlantic and the Pacific below $6 per ton, via the canal, and we may easily foresee what will be the future course of commerce. The routes across the isthmus and Central America have been explored and surveyed both by England and the United States, and the estimates for one of them are below the cost of the Suez canal, while the prospects of business are far more encouraging. The Suez canal commands the trade between India and Europe, but cannot control the commerce of China and Japan with the United States, or more than half of that between the same countries and Europe, while a ship canal between the Gulf of Mexico and the Pacific will eventually command twice the tonnage that now passes through the Suez canal.

"It will be a candidate for the vast export of wheat and other grain from our Pacific coast to Europe. The annual production of wheat on our Pacific coast exceeds a million tons, and will soon require a million tons of shipping to convey it to Europe. The ships would pass twice through the canal, and give it two millions of tonnage. The vast coasting trade of the United States between the Atlantic front and California, Oregon and Alaska would pass through this canal both going and returning, and the varied products of the Pacific coast, in the shape of timber, fish, copper ore, and extent of cargoes would, together, add another million to its tonnage. The commerce of the United States alone through this canal will supply a tonnage equal to that which pays six millions of dollars each year to the Suez canal. It will be a candidate for ships on their voyages from Europe for tea to China and Japan, and on their return, and will take nearly the whole tonnage passing between the Atlantic States, China, Japan and the Philippine Islands, and between Europe and the Russian possessions, and best accommodate the ships engaged in the whale fisheries of the Pacific. Tea, to the extent of two hundred millions of pounds, and occupying one hundred thousand tons of shipping, forms one item of its commerce, which will annually send through the canal nearly a quarter of a million tons of shipping. Then we have the trade between Australia and Europe, one item of which—wool—amounts yearly to three hundred millions of pounds. We may safely calculate that the Australian ships, out and back, will patronize this canal to the amount of three hundred thousand tons.

"Peru, with its guano amounting to three or four hundred thousand tons sent annually to Europe; Chili, with its copper and nitrates and return cargoes, with Guatemala, Mexico, and Central America, must furnish at least another million tons. Then we have the growth of this commerce while the work progresses, together with that due to new facilities, so that the aggregate must reach between five and six millions of tons—nearly twice the tonnage which passes yearly through the Suez canal. This estimate is not a high one. Ten years since, before the grain trade of California had attained any importance, the tonnage that would seek the canal was set at 3,300,000 tons by Admiral Davis, of our navy, and the annual saving in cost of freight, interest and insurance on the property to be transported by this canal, was set by him at ninety-nine millions of dollars.

"The estimate seems to be a high one, for it exceeds the computed cost of the canal itself; but the saving must be immense, as this trade is fast increasing, and the cost of transportation may be lessened two-thirds by a ship canal. California has become the chief granary of Great Britain, which now requires annually from other nations two hundred million bushels of grain. She prefers the wheat of California to grind with her own moist wheat, and there is no country but California where one man can successfully cultivate five hundred acres of wheat unaided by either man or fertilizer. With this canal completed, the grain of San Francisco, which is now more than four months on its way to Boston or Liverpool, could be landed there in less than three weeks. The vessels transporting it, instead of making one trip yearly, would accomplish many trips, by the aid of steam, now prohibited by the length of the voyage.

"To the United States the canal will be most useful in developing the products of the Pacific coast and exchanging them for our manufactures. To the British Isles it is even more important, as they draw one-fifth of the wheat they consume from California and Oregon, and by means of this canal may save annually a million sterling in freight. To France it is important for the diffusion of her manufactures over the isles and coasts of the Pacific, while the whole continent of Europe, and most of South America, are deeply interested in this enterprise."

A Singular Explanation of the Cause of London Fogs.

We glean from the London *Architect* that Dr. Frankland, a chemist of high repute, has just concluded an investigation into the cause of the persistency and irritating character of the fogs with which the vicinity of London is particularly afflicted.

Dr. Frankland's conclusion, as given in our contemporary, is highly interesting and singular. He finds that the fogs occur in comparatively dry air, and that they cannot therefore be considered as a sign of dampness. Their persistency in a dry atmosphere he has found, according to our authority, to be due to a coating of oil, derived from coal smoke, upon the surfaces of the minute vescicles of water composing the fog, and which effectually hinders the evaporation of the water. The discharge of such oleaginous matter into the atmosphere in immense quantities, by reason of the incomplete combustion of bituminous coal universally employed as fuel, is quite comprehensible; but that it should have the effect above noticed, is a singular and unexpected operation.

Dr. Frankland is further credited with the assertion—the rational conclusion of his observation—that by substituting smokeless coal, coke or gas in place of bituminous coal for firing purposes, the fogs of the city would be things of the past.

We look upon the foregoing statements as highly interesting, but cannot help thinking that Dr. Frankland's observation has been somewhat overdrawn in respect to the conclusions our authority draws from it. Dr. Frankland's statement, as we have it, is that the persistence of fogs in a dry medium is due to the oleaginous impurities present in the air of the city; and this statement appears to be very reasonable, but it does not warrant the succeeding statement that the substitution of other forms of fuel for bituminous coal would entirely do away with town fogs. These are caused by climatic influences beyond the control of the people and their domestic habits, these latter serving, as Frankland is careful to state, simply to aggravate the nuisance by causing its persistence when it would otherwise have disappeared. While the suppression of bituminous coal fires might therefore be expected to lessen the evil, we feel quite safe in saying that Dr. Frankland would not venture to affirm that London's fogs would cease, for London fogs were matters of history long before bituminous coal was known or used within her walls.

Cams.

(Concluded from Page 83 of April Number.)

In what has preceded, we have considered the cam to be a plane curve or groove, but in practice there is no such restriction as to its form. The following illustrations will show the extension of which it is capable. C D (Fig. 7) is a rectangle with a slit R S cut through it obliquely. A pin P, fixed to the sliding bar A B, works in the slit. If the rectangle C D be moved in the direction R S, it will impart no motion to the bar A B; but if it be moved in any other direction, the pin P will be pushed to the right or the left as the case may be, and the bar A B will have a longitudinal movement imparted to it.

The contrivance here sketched is of frequent use in some form or other. As an example, we may refer to

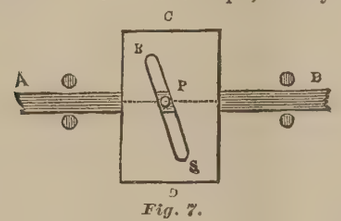


Fig. 7.

its application in the rifling bars used at Woolwich in in the manufacture of rifled guns. In work of this kind, where the greatest accuracy is demanded, the bore of the gun acts as a guide to the head of the rifling bar, and the cutter does its work while the bar is being twisted and pulled out of the gun. It is essential, therefore, to keep the cutter within the head while the bar is being inserted preparatory to the removal

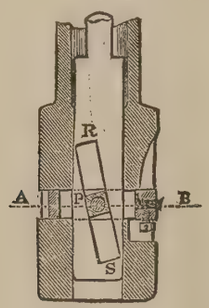


Fig. 8.

of a strip of the metal, and to bring it out again at the end of the stroke. In order to arrive at this result, the bar is made hollow, and the tool holder in the rifling head, shown in Fig. 8, is made to move in and out laterally by means of a pin P working in an inclined slot R S in the internal feed rod. As the feed rod is pushed through a small definite space in either direction along the axis of the bar, the cutter will also move in or out in the direction of the dotted line A B.

A further extension of the capabilities of this device will appear if we imagine C D to be wrapped around a cylinder (Fig 9). It will form a screw-thread, and the revolution of the cylinder upon its axis will be equivalent to a motion of the rectangle at right angles to the

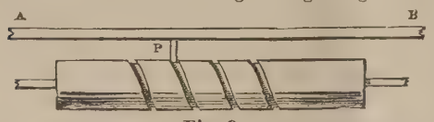


Fig. 9.

bar, in the manner shown in the preceding paragraph. The effect of the revolution of the cylinder upon which the screw-thread is traced will be to produce a rectilinear motion of the bar A B. If the pitch of the screw be constant, the motion of the bar will be uniform, but any change of velocity at any portion of the movement may be introduced by a suitable variation in the direction of the screw-thread. If the screw be changed into a circular ring, the bar A B will not move at all.

It is thus a matter of indifference whether the cam be a groove traced upon a flat plate, or a spiral helix running round a cylinder. In the first case, motion ensues when the groove departs from the circular form, and the distance from the center varies; in the second case, motion ensues so soon as the groove begins to deviate from the form of a ring, whose plane is perpendicular to the axis. An illustration of a cam of the latter character is shown in Fig. 10, which represents

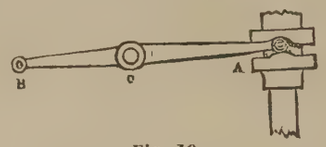


Fig. 10.

a form very much employed where a small motion of a lever is required. The lever A C B is centered on the pivot C, and will commence to move as soon as the pin at the end A reaches that portion of the ring which departs from the circular form. (This kind of cam has the property of giving a motion parallel to the axis upon which it is shaped).

We subjoin an example in which a reciprocating movement is imparted to a frisket frame in printing machinery. The use of a cam plate gives an interval of rest at each end of the motion, and enables the printer to obtain an impression and to place a fresh sheet of paper upon the form. In the cut (Fig. 11) A H is the reciprocating frame attached to the combination of levers G F E D C B by the link A B. At the end of the lever F G is a sliding pin, which travels along the grooves in the flat plate centered at O, and determines by its position the angular motions of the levers about the fixed centers at F and C. Where the groove is circular, which occurs in these portions which are to the left of the vertical dotted line, the levers remain at rest, and they change into the position indicated by the dotted lines, when the sliding pin passes from the outer to the inner channel. The pin has an elongaged form, which enables it to pass freely across the intersections of the groove.

A movement of precisely the same character may be obtained by the aid of a helical groove traced upon a revolving drum. The intervals of rest occur when the groove assumes the form of a flat ring whose axis is perpendicular to the axis of the drum. A right and left handed screw-thread is traced upon the worm-barrel A B, Fig. 12, which revolves in one uniform direction. A pin attached to the table of a printing machine follows the path of the groove upon the barrel, and its form is elongated so as to enable it to pass in the right direction at the points where the grooves intersect. The interval of rest commences with the entry of the pin into the flat ring at both ends of the barrel, and may be made to occupy the whole or any portion of a revolution of A B, according as the grooves enter and leave the ring at the same or different points. The required movement is thus obtained in a much simpler manner than with the arrangement shown in Fig. 11, since it disposes altogether with the complicated system of levers.

Fig. 13 represents a construction which causes the interval of rest to endure beyond the period of one revolution. At the entrance to the circular portion of the groove a movable switch is placed, which is capable of twisting a little in either direction upon its point of support. It is provided also that the pin on which the switch rests shall admit of a small longitudinal movement parallel to the axis of the barrel, the pin itself being urged constantly to the right hand by the action of a spring. In sketch *a* (Fig. 13) the shuttle is seen entering the circular portion of the groove, and twisting the switch into a position which will allow the shuttle to meet it again as in *b*, and to make a second journey around the circular ring. The spring, which presses the point of support of the switch to the right hand, will now cause it to twist by means of the reaction which the passing pin affords, and the consequence will be that the switch will be left in the position shown in *c*, and will guide the shuttle into the helical portion of the groove. Thus the period of rest will be that due to about one and two-thirds of a revolution of the barrel.

In certain cases where it is required to effect a movement with extreme precision, cams are employed. Fig. 14 shows an attachment to a printing press, which is designed to make the sheet of paper meet the type at a particular instant of time and where an error of $^1/_{12}$ of a second would throw the impression entirely out of correct position. As C revolves, the roller at B drops into the hollow of the plate, thereby determining the fall of the lever A B, and by it also the fall of another roller which starts the paper on its course to the printing cylinder.

Fig. 15 shows the applicability of the cam to give a rapid motion with intervals of rest. In the expansive

Fig. 12.

working of a steam engine, there are two positions of rest for the valve which regulates the admission of steam into the slide case. As it is desirable to effect the motion of the valve as rapidly as possible from one position to the other, the form of the expansion cam (Fig. 15) is employed.

Where the cam plate is required to effect more than one double oscillation of the sliding bar during each revolution, its edge must be formed into a correspond-

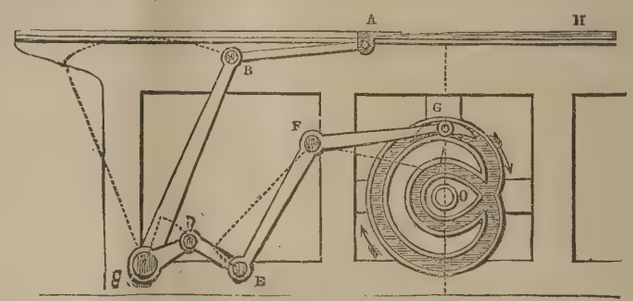


Fig. 11.

ing number of waves. Such a construction is shown in Fig. 16, which illustrates a device employed in telegraphy, where it is desired to cause frequent interruptions of the electric current. This is accomplished by the vibrations of the lever P C Q, centered at C, and whose angular position is modified by a pin traveling in the groove.

Fig. 17 shows the application of the cam to the striking mechanism of a large clock, where the hammer is raised by the cam and then allowed to fall abruptly.

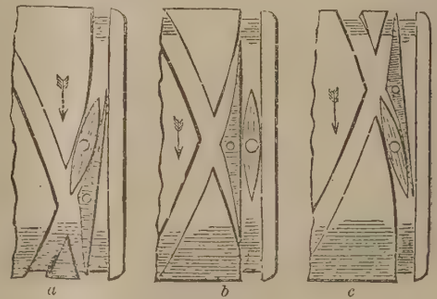


Fig. 13.

The hammer rises and falls with the lever A C, and the cam is so formed that its action commences at the extremity of the lever and never departs sensibly from the same point. The cam *a b* is a circle whose center is at the point of intersection of the tangents to the rim of the wheel at the points *a* and *c*.

In conclusion it may be remarked, that when the moving body is influenced by a pin which exactly fits the groove in which it travels, it must take the ex-

act position determined by the pin. On the other hand, when the cam is merely a curved plate, pushing a body before it, there is no certainty that this body will return, unless it is brought back by a weight or spring. Hence double cams have sometimes been employed in machinery, an example of which we copy from an early form of power loom. A B (Fig. 18) is the treadle;

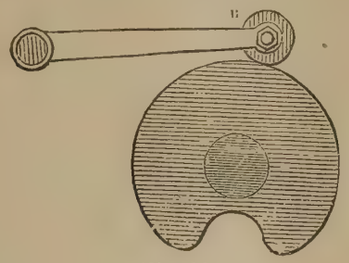


Fig. 14.

E and F are the cam wheels or tappets, which revolve in the direction shown by the arrows, and in such relative positions that the projections and hollows are always exactly opposite to each other. As the cams rotate, the treadle A B is alternately elevated and depressed, and the threads of the warp are opened so as to permit the throw of the shuttle during the operation of weaving the fabric.

Tempering Steel Springs.

The following very practical hints on this subject are communicated by Mr. Joshua Rose, a well-known writer on mechanical subjects, to the *Wheelwright and Blacksmith.* Like most of this writer's publications, the present one will be found to convey much practical and useful information:

"Tempering to impart to steel its maximum of elasticity, is a branch of the art requiring, to obtain the best results, the most expert manipulation. This is especially the case where the springs are subject to severe strains in proportion to their dimensions, while at the same time subject to vibrations. Under these conditions the least degree of undue hardness causes a spring to break, while undue softness causes it to bend to a permanent set, thus altering its normal form. For instance, if a spiral spring, whose coils are distended by force applied at the ends, 'sets,' the coils, when released from distention, will not approach each other to the distance they did before distention, the amount of difference being the amount of the 'set.' Or, if the coils were compressed and failed, when released, to resume their natural positions relative to each other before compression, the spring has 'set.' Hence the relation between the length, breadth and thickness of a spring, and the nature and amount of its duty are vital elements in estimating the quality of its temper.

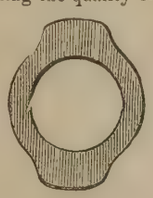


Fig. 15.

"The commonest method of spring tempering consists in first hardening the steel, and then blazing it off by heating it in connection with some fatty combustible compound, which will take fire and blaze when it has acquired a certain temperature, it being found that the temperature at which heavy oils, tallow, etc., take fire is about that necessary to reduce a well-hardened spring to the degree of temper imparting to steel its greatest elasticity.

"Here we have two separate operations—hardening and tempering; and to avoid this, and temper at once, without the intervention of hardening, is an object of great importance. It has been accomplished, however, in several cases. Thus, one of our largest spring manufacturers tempers spiral springs as follows: They use Gregory's crucible steel, heating it in a furnace burning gas coke, but the furnace has a return flue and heating chambers, and ovens between the flues, the heat passing through the brick-work forming the flues, into the ovens. To facilitate renewing the ovens (which of course also renews the flues), the floor of each oven—which forms the ceiling of the oven below—is built on iron supports, protected by the brick-work and suitable fire clay, the bricks all being made to pattern, thus involving very little labor in building. The furnace doors are at the ends, and are kept closed as much as possible. In this way the steel has no contact with the products of combustion of the fuel, and the air is excluded as far as practicable (two valuable features). The furnaces are long and narrow, and not being connected with the flue, there is but little disposition for the cold air to rush in when the furnace doors are opened.

"The hardening and tempering of springs whose coils are of thick cross section is performed at one operation, as follows: The springs are heated in the furnace or oven described, and are first immersed for a certain period in a tank containing fish oil (obtained from the fish 'moss bunker,' and termed 'straights'), and are then removed and cooled in a tank of water. The period of immersion in the oil is governed solely

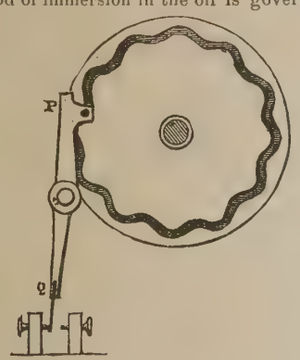


Fig. 16.

by the operator's judgment, depending upon the thickness of the cross-section of the spring coil, or, in other words, the diameter of the round steel of which the spring is made. The following, however, are examples:

Number of coils in spring	5¾
Length of the spring	6 inches.
Outside diameter of coils	4¾ "
Diameter of steel	1 "

The spring was immersed in the oil and slowly swung back and forth for 28 seconds, having been given 35 swings during that time. Upon removal from the oil the spring took fire, was re-dipped for one second, and then put in the cold-water tank to cool off.

"Of the same springs the following also are examples:

Example.	*Time of immersion in oil.*	*Number of swings in oil.*
Second	36 seconds.	46
Third	26 "	36
Fourth	38 "	40

SIZE OF SPRINGS.

Number of coils in the springs	6
Length of the springs	9 inches.
Inside diameter of coils	3¼ "
Size of steel	1x1½ sq.

Example.	*Time of immersion in oil.*	*Number of swings in oil.*
First	9 seconds.	12
Second	8 "	12
Third	8 "	12
Fourth	9 "	12
Fifth	9 "	12
Sixth	9 "	12

"To keep the tempering oil cool and at an even temperature, the tank of fish oil was in a second or outer tank containing water, a circulation of the latter being maintained by a pump. The swinging of the coils causes a circulation of the oil, while at the same time it hastens the cooling of the spring. The water tank was kept cool by a constant stream and overflow. If a spring, upon being taken from the oil, took fire, it was again immersed as in the first example.

"In this, as in all similar processes, resin and pitch are sometimes added to the oil to increase its hardening capacity if necessary.

"The test to which these springs were subjected, was to compress them until the coils touched each other, measuring the hight of the spring after each test, and continuing the operation until at two consecutive tests the spring came back to its hight before the two respective compressions. The amount of 'set'

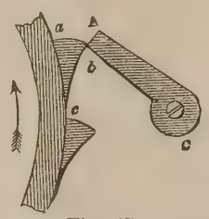


Fig. 17.

under these conditions is found to vary from three-eighths of an inch, in comparatively weak, to seven-eighths of an inch for large, stiff ones."

Boiler Bracing.

The Engineer-in-Chief of the United States Navy, in a recent report on experiments in boiler bracing, gives the results of some interesting trials on the strength of screw stay bolts. The average strain in pounds required to pull the 1-inch or 1¼-inch iron bolts through the ¼-inch iron plate, was as follows:

WITH SUPPORTS 4 INCHES FROM CENTER TO CENTER.	
1-inch bolt, not riveted	21,970
1-inch bolt, ordinary low conical head, three threads left through for riveting	25,147
1-inch bolt, button head; length of bolt left through for riveting equal to 7-16 diameter of bolt	33,791
1¼-inch bolt, button head; length left through for riveting equal to one-half diameter of bolt	38,885
WITH SUPPORTS 5 INCHES FROM CENTER TO CENTER.	
1-inch bolt, ordinary low conical head	22,137
1-inch bolt, button head; length left through for riveting equal to 7-16 diameter of bolt	31,282
1¼-inch bolt, button head; length left through for riveting equal to one-half diameter of bolt	35,812

The cause of the inferiority of the ordinary low conical head bolts is explained in the following way: It was observed that the bulging of the plates caused the lap of the rivet-head on the plate to commence giving way or breaking off some time before the maximum strain was reached, thus leaving more for the threads of the bolts to sustain. As the strain and bulge of the plates increased, the plate around the bolt turned downward

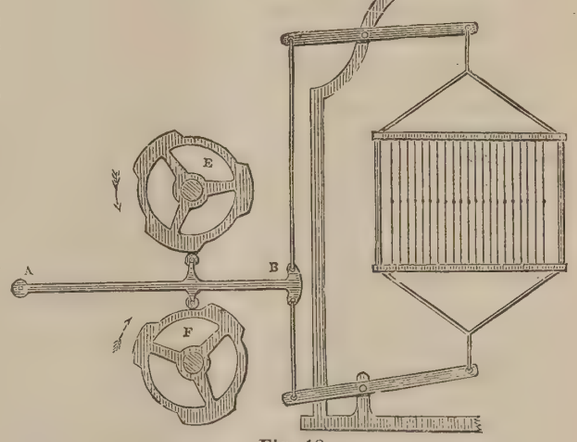


Fig. 18.

and outward, until the threads in the plate almost entirely cleared those in the bolts, so that in almost every case there were only from one to two threads stripped or injured on the bolt when it drew out; therefore, it was deemed advisable to form the head in a different manner, and after several experiments it was decided that the rivet-head should be made as follows: First, by having as much of the bolt through the plate as could be riveted over without injury to the iron, which was, in case of the superior iron being used, equal in length to about one-half the diameter of the bolt.

Scientific.

Important Spectroscopic Observations.—Herr H. W. Vogel affirms, in a paper sent to the German Chemical Society, that he has succeeded in detecting a number of new lines not hitherto noticed in the spectrum of hydrogen. According to the views hitherto prevalent, the spectrum of hydrogen consists essentially of four lines. Vogel took a number of photographs of the spectrum of hydrogen in Geissler tubes filled with the gas, and obtained, along with the four lines already known, a great number of others, among which several in the violet and ultra-violet were distinguished by their intensity and definiteness. Vogel affirms that to make sure that these new lines pertained to hydrogen itself, and not to any admixture of foreign gases, he repeatedly photographed the spectrum of electrolytic hydrogen, which he held to be unquestionably pure, and having obtained the same lines in every case, he has no hesitation is ascribing them to hydrogen.

Among these new lines, one is particularly remarkable for its brightness and for its coincidence with Fraunhofer's line H′, generally attributed to calcium, to which body Fraunhofer's line H″ also belongs. From the existence of this conspicuous line, which he designates as the fifth main hydrogen line (Hδ), the author draws some interesting conclusions bearing on Lockyer's alleged discovery of the dissociation of calcium at high temperatures.

Lockyer, founding on the fact that the spectrum of calcium becomes modified at elevated temperatures, has conjectured that this body becomes dissociated at such temperatures into two elements, X and Y, to one of which the first H line belongs, and the second to the other. He has not, however, thus far succeeded in effecting this dissociation of calcium with terrestrial sources of heat. He (Lockyer) believes that this takes place in the high temperature of the "white" fixed stars, which are regarded as the hottest. He depends on an observation of Huggins', who has photographed the spectra of Sirius and Vega, and has ascertained that in them only the first of the two thick H lines of the solar spectrum is present, the second being either entirely absent or barely visible.

Vogel explains this fact differently, and ascribes the solitary H′ line seen in the spectra of the fixed stars, not to calcium, but holds it to be the fifth line of hydrogen. He holds also that this opinion is supported by the fact that the (other) hydrogen lines are developed in a conspicuous manner in the spectra of these stars—more intensely than in the solar spectrum; and by the fact that in Huggins' special observation of the star lines in the violet and ultra-violet, in addition to the well-known hydrogen lines, the others agree so manifestly with those he has observed in his photographs, that their identity can scarcely be doubted. He affirms his belief, therefore, that Lockyer's conclusion as to the dissociation of calcium, based on the foregoing observations, is not justified, and that, on the contrary, the isolated appearance of the H′ line (without H″) is simply the fifth line of hydrogen (Hδ).

Bi-Sulphide of Carbon Engines.—The idea of utilizing the elastic force of the vapors of certain volatile liquids like ether, bi-sulphide of carbon, etc., which, as they boil at comparatively low temperatures, evolve an elastic vapor exerting high pressures at temperatures considerably below the boiling point of water, and which, in addition, have the advantage over steam of having a comparatively low latent heat, has frequently been advanced by enthusiastic inventors.

In some of these projects, the plan of the inventor has been to use bi-sulphide of carbon (or some equivalent volatile compound) in the generator in place of water; and in others, which seem to us to promise better results in practice, the inventor has made an effort to utilize, by means of such readily vaporized liquids, the heat remaining in the exhaust passed from the engine, to generate an additional quantity of vapor, the elastic force of which, utilized through the instrumentality of mechanism employed in connection with the device, was just so much power directly gained.

Neither of these ideas has thus far met with any notable success, and apparently for the following reasons: (1) All, or nearly all, the volatile liquids suited for this particular application, have such a solvent power for oils, fats, etc., as to render the question of lubrication a very difficult one; (2) and leakages, which are unavoidable, to a greater or lesser degree, interpose the objection of filling the atmosphere of the engine room with an inflammable and explosive vapor.

These difficulties and objections are claimed to have been practically overcome in a recent invention which has met our eye. This latest engine, as we draw from the description of it, does not differ substantially from the common low pressure engine with surface condensation, and the boiler is of the usual type. In operation, the boiler is about half filled with water, on which is poured a few gallons of petroleum oil. The water is heated almost to the boiling point, the pump is set to work, and a small quantity of bi-sulphide of carbon is thrown in at each stroke, the quantity being regulated according to circumstances. The bi-sulphide at once absorbs heat from the water, generating a vapor of greater or less pressure, according to the action of the pump. Here, it is claimed, the utility of the petroleum previously added manifests itself, inasmuch as the small quantity of its vapor which is carried along with that of the bi-sulphide, being itself a lubricant, supplies enough for all the interior rubbing surfaces, and substantially neutralizes the destructive action of the bi-sulphide on that which is used on other parts. After passing the engine, the vapor is carried by the exhaust pipe to the condenser, where it is condensed, and falls into the reservoir, from which it is pumped by the feed-pump back again into the boiler, and so on. The claim is made that the same quantity of bi-sulphide can be used over and over again, and very considerable pressure obtained without heating the water in the boiler to the boiling point.

In the absence of any personal knowledge of the practical working of this device, we must refrain from passing any judgment on its merits. We therefore simply present the foregoing facts, which have come to us as a piece of current scientific news.

A New Method of Preparing Sulphuretted Hydrogen for laboratory and other uses, and which may prove to be well adapted for the requirements of toxicological investigations, is described as follows by Mr. J. Fletcher in the London *Chemical News*: The method, it appears, was first described by Walter Skeye in the same journal, and consists in heating roll sulphur with paraffin in a glass flask, and conducting the gaseous product into the solution to be treated. The gas which is at first given off is not sulphuretted, but when the mass becomes thoroughly mixed, hydrogen sulphide is given off abundantly. When the heat is withdrawn, the evolution of gas ceases at once. The method is a simple, elegant and cleanly substitute for the older methods in vogue, and appears to be especially well suited for small laboratories.

The objection of violent bumping, amounting even to violence, which has been advanced against this method, it is said by the author, may be entirely obviated by introducing a few pieces of broken tobacco pipe-stems. To avoid the volatilization of the contents of the flask, the heating should be moderate; and to avoid drawing back into the generator the contents of the solution treated, the heat should be continued until the tube conducting the gas is withdrawn.

The Influence of the Electric Light on Vegetation.—Dr. C. W. Siemens has opened a novel and interesting line of investigation in some experiments he has just reported to the Royal Society, on the influence of the electric light on the growth of plants. These experiments were made with mustard, carrot, bean, cucumber, melon and other rapidly growing plants. These were planted in pots and arranged in four groups; one group was kept continuously in the dark; a second, in the light of day as long as possible; a third, in the electric light; and the fourth, to daylight and the electric light in succession. He found that the plants kept in the dark speedily died, and that they throve about equally well in the electric light as in daylight. Those plants, however, did best of all which were constantly exposed to daylight and electric light in succession.

These experiments extended through a period of two months, and point clearly to certain important conclusions. They show that plants do not require any rest during the twenty-four hours; that their growth may be materially quickened by giving them the benefit of the electric light at night; that the electric light will produce chlorophyl in the leaves of plants, and promote their growth; and that injurious effects upon plants are not caused, to any material extent, by the small amount of carbonic acid and nitrogenous compounds generated in the electric arc. Dr. Siemens expresses the opinion that the injurious effects of night frosts might be counteracted and the ripening of fruits promoted by the use of such lights. He stated that a light equal to 1,400 candles, at a distance of 6 or 7 feet from growing plants, appeared to be equal in effect to average daylight at this season of the year. In illustration of his theme, he had placed some budding tulips in a strong electric light, and in about 40 minutes it had caused them to open out in full bloom.

Vesbium, an Alleged New Element.—In the *Chemical News* we find an abstract of a paper read before the Neapolitan Academy of Sciences, by Signor A. Scacchi, on the composition of certain green and yellow incrustations which appear in certain fissures in the Vesuvian lavas of the year 1631. These incrustations consist of silicates containing copper, lead, and a body which he considers to be new, and which he proposes to call "Vesbium," from the ancient name of Vesuvius.

The small quantities of this substance have permitted only a preliminary examination. It appears, however, to be a metallic acid of a red color, giving colorless alkaline salts, which turn yellow on the addition of an acid. The silver salt is red or orange; the copper salt a yellowish-green. Sulphuretted hydrogen gives a brown precipitate, and a blue liquid which is rendered brown by zinc. Before the blow-pipe it communicates to microcosmic salt a yellow color in the outer flame, and a green in the inner.

The author does not believe in the presence of molybdenium or vanadium, though the presence of the latter seems to be indicated. Further investigation will be required to determine the genuineness of this alleged discovery.

A Harmless Green Pigment.—The very general aversion of green pigments entertained by the well informed public, by reason of the suspicion that they may contain dangerous quantities of arsenic, is well founded. On this account, it may be of interest to notice that M. Casali has claimed to have produced a green coloring matter suitable for wall papers, and other similar uses, by calcining an intimate mixture of one part of bichromate of potassa and three parts of baked gypsum. A grass-green mixture is obtained, which, on boiling with water, or on mixing with dilute hydrochloric acid, leaves a fine powder of an intense green color.

This suggestion seems to us to be very useful, as many serious and even fatal accidents have been directly traced to the poisonous effects of arsenical greens on paper used for wall coverings, bon-bon boxes, and the like. The above recipe, if it produces a product as good as is claimed, will be not only free from objection on account of its freedom from danger, but also quite cheap.

Concerning Norwegium, an Alleged New Element.—Dahll has communicated to the *Zeitsch. d. Geol. Gesell.* some additional facts concerning his alleged discovery of a new element (Norwegium) in the red nickel pyrites of Krageröe. He finds it white, not very ductile, specific gravity 9.44, melts at 350°, and dissolves in nitric acid with a blue color, which becomes green on dilution. The solutions are precipitated green by

alkalies, but the precipitate is dissolved in excess with blue color. Sulphuretted hydrogen gives a permanent brown precipitate. Before the blow-pipe it gives yellow glasses, which become blue on cooling, and on charcoal with soda it forms a yellowish-green coating.

Bismuth is one of the metals which has thus far not acquired much importance in the arts. The metal plays an important part in the manufacture of fusible alloys for safety plugs in steam boilers, and other useful and experimental purposes. Its salts, especially the sub-nitrate and the oxide, are used to some extent in medicine and in the preparation of cosmetics; but all these uses combined do not bring the consumption of the metal annually above a few tons.

There appears to us to be a field for our metallurgists to pay some attention to the question of finding other and larger uses for this metal, since it could be supplied in almost unlimited quantity if a demand for it were once created by opening some new avenue through which it could be utilized. In Utah, as has lately been made known, several enormous deposits of bismuth have been discovered in Beaver county, which, if developed, are sufficiently rich to yield thousands of tons of this metal. Here is an opportunity for our practical chemists to turn a discovery to profitable account.

Hints on the Use and Selection of Rubber.—R. Grimshaw gives the following practical items bearing on the above, in the latest *Journal of the Franklin Institute:* To cut India rubber easily, keep the knife blade wet with water, or, better still, with caustic potash. Rubber valves for steam, or for oil, should be specially ordered for the purpose desired, as they require to be vulcanized at a higher temperature, or for a longer time. In buying rubber goods, such as car springs, buffers, etc., choose light ones—heavy ones are loaded up with barytes, etc. Color is no test. Never buy old India rubber goods, as that material perishes with age.

The Atomic Weights of Certain New Elements.—Dahll, who has reaffirmed the genuineness of his alleged discovery of a new element (Norwegium) in the copper nickel of Krageröe, finds its atomic weight to be apparently 145.9. A. Guyard, who lately announced the existence of a new member of the platinum group, which he called Ouralium, announces its atomic weight to be 187.25. In addition to this, Guyard states that his new metal is, after silver, the whitest metal known. It is more ductile than platinum, which it equals in malleability, soft as lead, has a melting point near to that of platinum, and specific gravity of 20.25. In chemical properties it is difficult to distinguish from platinum.

Manganese Bronze.

The foreign technical journals have lately contained many flattering references to the pronounced successes that have been attained in the use of the special alloys known by the trade name of "manganese bronze." The manufacture of these alloys, under the patents of Parsons, is now carried on systematically and certainly, and the qualities and adaptability of the several grades of the metal have been as definitely established as is the case with steel. At a recent industrial exhibition in Germany, much surprise was excited by the extent of the display of these alloys and the variety of applications of which they were shown to be susceptible; and in England, we learn, even greater success in their manufacture and use has been achieved.

The process of manufacturing manganese bronze is instructive, as illustrating a principle of metallurgy well understood and employed in the Bessemer process of steel manufacture. The procedure consists in incorporating with any of the copper alloys, whether gun-metal, bronze or brass, a certain proportion of ferro-manganese. In preparing the ferro-manganese for this purpose, great care is exercised. It undergoes a special refining process for the elimination of its silicon, and it is at the same time prepared in four different grades, each varying in their relative proportions of manganese and iron, according to the nature of the bronze required. The ferro-manganese is melted in a separate crucible, and is added in a liquid state to the copper alloy, which must have been brought to a very high temperature to insure that the proper combination shall be effected.

Immediately on the addition of the ferro-manganese, a very similar phenomenon occurs to that which takes place when it is added to the decarbonized iron in the Bessemer converter, namely, the free metallic manganese, having a strong affinity for oxygen, seizes upon and clears out of the copper any oxide of the metal which it may contain, and renders it more dense and homogeneous. In this operation a portion only of the manganese is utilized, the balance combines with the copper alloy, and plays an important part in imparting to the finished product certain desirable properties which characterize the manganese bronzes, and which, from the experience gained in the manufacture, can now be regulated with the utmost nicety.

In practice, four different grades of manganese bronze are made. No. 1 has the property of forging, rolling and working at a red heat, as well as cold, and for this purpose it is cast in metal molds into ingots or slabs, from which it is rolled into rods, plates and sheets, or forged into such shapes as may be required. In this state, the statement is made, that the metal, when annealed, has the strength and toughness of the best Bessemer or Siemens-Martin steel, having, on the authority of (London) *Iron*, a tensile strength of 30 tons per square inch, an elastic limit of from 15 to 16 tons, and stretching from 20 to 40 per cent of its length before breaking.

This material is said to be coming largely into use as a substitute for yellow metal for such articles as pump rods, bolts and screws, and for numerous purposes where great strength and toughness are required, and where steel, from its tendency to rust, is inadmissable. A torpedo boat has been built entirely of manganese bronze of this quality, the conditions of its construction being that the material should stand the Admiralty tests for steel. These conditions were successfully met, and thus a new and important application for the metal has been opened.

No. 2 is described as being of similar quality to No. 1, above referred to, but has even greater strength. It also admits, under certain conditions, of being cast in sand, in which state it is claimed to be fully as tough and strong as good wrought iron. A bar of one inch section, cast in sand, placed on supports 12 inches apart, required 4,250 pounds, applied in the center, to break it, and before yielding showed a deflection of nearly 2½ inches. This quality of metal can also be rolled and worked hot into rods, plates and sheets, drawn into wire and forged into shapes.

No. 3 is described to be a superior kind of gun-metal, and, according to the authority we have quoted above, is now generally superseding ordinary gun-metal for most engineering purposes, and especially in connection with marine engines. In many large vessels lately built, manganese bronze has been used in place of gun-metal for the main bearings, crank pins, etc., and in a very superior vessel now being constructed for the Czar of Russia, the propellers are to be of this metal. Careful experiments are said to have demonstrated that this No. 3 metal has 60 per cent greater strength than the best gun-metal; hence with equal strength, there will be a decided saving in weight in the use of the manganese bronze.

No. 4 is said to be specially useful for frictional surfaces, such, for example, as oscillating bearings, slide valves, slide faces, piston rings, pump valves, etc. This quality is claimed to possess three or four times the durability of gun-metal, and to work up to a perfect surface. It has shown itself to be very efficient for large trunnions and other bearings and piston rings working at a high temperature, and is now being tested for bearings of railway cars.

London *Iron*, from which we glean many of the foregoing facts, concludes a lengthy editorial on manganese bronze in the following words: "For the many purposes for which ordinary brass is used, there would seem to be a wide field of application for this new metal, as by the combination of the ferro-manganese, brass as well as bronze is greatly increased in strength, with but little addition to its cost. . . . On the whole, manganese bronze appears to be coming largely into use, and as its merits become known, its adoption in place of some other metals, especially gun-metal, will probably become very general."

Bonsilate.

One of Newark's (N. J.) latest industries is the establishment of a company engaged in the manufacture of a new product intended to substitute ivory, hard rubber and kindred substances employed in the manufacture of a variety of useful or decorative articles. The material is said to be composed chiefly of finely ground bone, which is agglutinated by the addition of some cementing compound. From the peculiarity of the name, we should suspect this to be silicate of soda, though our account states that it is at present the secret of the manufacturers. The name of J. W. Hyatt, which is mentioned as one of the inventors of "bonsilate," will be recognized as that of one of the inventors of the singular composition known as "celluloid."

The manufacture of this new product is said to have progressed so far that already a large variety of articles are made of it and placed upon the market. The material can be molded in dies like any other plastic composition. It can be formed into slabs, bars or sheets, which can be turned, polished, or sawed into desired shapes; and by the addition to it of various coloring pigments, a variety of costly and decorative substances, such as coral, jet, malachite, colored marbles and other stones, can be closely imitated with it.

From the account given, it must, like celluloid, possess a high degree of elasticity, as one of the leading companies of this city is reported to be making billiard balls of it. In addition, it is being used for cane and umbrella handles, checkers and dominoes, door knobs, buttons, clock cases and the like, in imitation of the costly marbles.

A number of other projected uses for the new product are given at length, but those we have named will suffice to give an idea of its probable utility. From the very imperfect account given of its composition, we should incline to the opinion that "bonsilate" promises to be a very cheap substitute for the materials above named, but we doubt if it will be found adapted for as great a diversity of uses as celluloid.

Rendering Cotton Goods Uninflammable.

Dr. Kedzie, of the State Board of Health of Michigan, in a recent address before a sanitary meeting in that State, made the very excellent suggestion that cotton fabrics—with special reference to articles of clothing—could be prevented from taking fire by the simple expedient of adding a little borax to the starch with which the goods in question are dressed. The quantity recommended is a teaspoonful of borax to each pint of starch after the latter is dissolved in water. The use of borax is entirely unobjectionable, being quite harmless and very cheap. The speaker showed by experiment that muslin, and even the most gauzy and inflammable textures, when treated with the borax starch, could not be made to take fire and burn with a blaze; and he most properly inferred that if cotton dresses and under-clothing of women and children were prepared by this simple method, many distressing accidents and frequent loss of life from the accidental ignition of clothing might be prevented.

The suggestion of Dr. Kedzie, though not altogether new, is none the less useful. The writer of this article made a similar suggestion to one of the leading starch manufacturers in this country some years ago, but was informed that there was no public interest in, and hence no public demand for, a fire-proof starch. Let housekeepers take the subject in hand, and make it themselves.

American Submerged Pump.

In our issue for November, 1879, we presented a description of this apparatus, illustrating it with an engraving showing the pump in the well, in action. We give in the following a more detailed account of the mechanism and action of the contrivance, from which a clearer idea of the merits claimed for it may be derived. The "American Submerged Pump" is a double-acting suction and force pump, designed for raising water from great depths and forcing it any required distance. It is adapted for fire, ship, house, factory, distillery and irrigating purposes. Its claims to this very general utility will appear from the subjoined description.

Fig. 1 represents a section of the body or cylinder

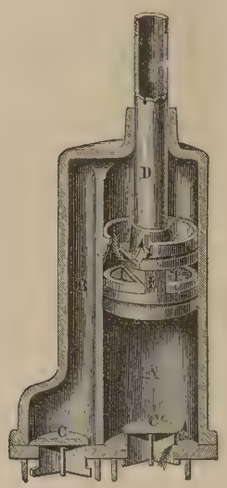


Fig. 1.

of the pump, and the essential parts of the apparatus consist of a lateral chamber provided with an inlet valve, by which device the pump takes water on both strokes; double shifting valves in the piston, through which the water above or below the piston, according to the direction in which it is moving, is forced up through a hollow piston stem, and through a connected pipe, which last performs the double duty of delivering the water and of moving the piston by means of the pump lever actuated on the ground surface above.

Referring to Fig. 1, it will appear that the pump chamber A will receive water during the up-stroke of the piston through the valve C′ below. The water already above the piston, which is prevented from escaping by the closing of valve C in the side chamber by pressure, is forced to escape down through the piston head by the valve there provided, and to pass, as shown by the arrow, into the hollow piston stem D, and up through the connected delivery pipe above referred to. The piston valves I and I′, held to their seats on the up stroke of the piston by water pressure above them, permit of the formation of a vacuum below the piston, by which the chamber A fills with water, while that previously above the piston is being delivered as above. On the down stroke, the valve C′ in the main chamber closes, valve C in the lateral chamber opens, the piston valves shift by pressure of water in the chamber to their upper seats, and the water below the piston is forced to escape into the piston stem D, under valves I and I′, and up through the connected conducting pipe. Meantime the space above the descending piston has been filling with water by atmospheric pressure, through the opened valve in the lateral chamber B. The action of the pump is therefore practically continuous.

Fig. 2 shows the operating lever M attached to suitable framing on ground level, and imparting motion through link P to the hollow piston rod, by the connected delivery pipe K.

Fig. 3 shows the pump body proper which is submerged in the well and braced in position against a vertical supporting post, which holds it firmly in position, to be set in action from the operating lever.

The manufacturer claims for this device, that in the operation of this pump the chief portion of friction due to packing (which it is usually estimated requires at least 33 per cent of the power applied) is saved, the piston being so fitted to the chamber as to act to a considerable extent as an air pump; hence, when submerged in water, it has a water packing and water lubrication. The channels for the water leading to the center line of the piston cause an equal bearing on all parts thereof, and a great saving of power, as may be readily shown by closing up one of the piston valves I and I′, and taking water from one side only, as is done in some other pumps; and that they maintain the continuous action of a rotary pump simply and economically without the use of an air chamber.

The advantages claimed for the American Submerged Pump, are: simplicity, as it is composed of few parts, all of metal; non-liability to freezing, as all the working parts are under water, and, having no piston packing, no water remains in the pipe when the pump is not in action; durability, since it requires no other lubricant than the water in which it works; adaptability to delivery of water from great depths, one man being able to draw water from a depth of 150 feet; and ability to compare favorably with other pumps in point of convenience, ease of adjustment, and capacity.

The manufacturer is Henry H. B. Bloomfield, of 34 Dey street, this city, who may be addressed for further information.

Labryinth of Pipes Under New York.

The network of conduits in the streets of New York was recently illustrated by a diagram in *The Iron Age* of the scene of a gas explosion at Forty-second street and Sixth avenue. In each thoroughfare are five lines of gas-pipe and a sewer; in Forty-second street two sewers and two lines of water-pipe, one of those in Forty-second street being a 48-inch main. On the surface of the avenue is a horse-railroad track and the double line of the elevated railway. All these lines intersect at the crossing; and in the air, spanning the intersection, is the station of the elevated road. The pipes are turned and bored and sagged to avoid each

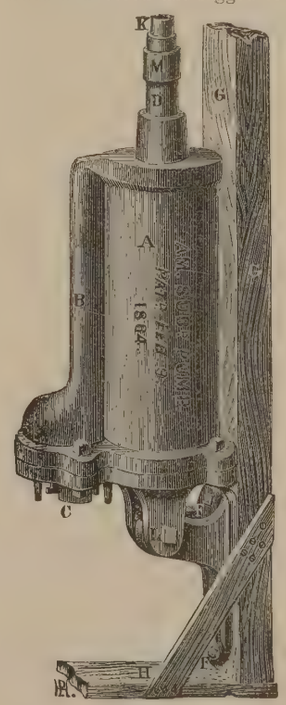


Fig. 3.

other, and the supports of the elevated road have to be planted as carefully as a man would tread among eggs; sometimes forking above the pipes, sometimes thrusting them aside, to get a footing; for the pipes are spread all across the streets, and there is no placing a line of rails so as to avoid them. *The American Architect* urges that if an engineer were called upon to provide at once for seven lines of gas and water pipes and a large sewer, to say nothing of steam-pipes and telegraph tubing, which may follow, to be put underground in a busy thoroughfare, full of vehicles, and pervaded by four railroad tracks, it is safe to assume that he would not dream of laying them side by side and burying them up in earth, so that every time that any one had to be visited the street must be blocked, and earth and pavement be removed and relaid. He would decide, that convenience and economy made it best, once for all, to construct a gallery in which all these conduits could be carried, and where, having been arranged once for all, they could be visited, examined, altered, replaced, tapped or repaired, without interfering with what went on at the surface of the street, without excavating and filling, repaving and repairing. The cost of these subways is large, but yet it is trifling compared with that of laying out or widening new

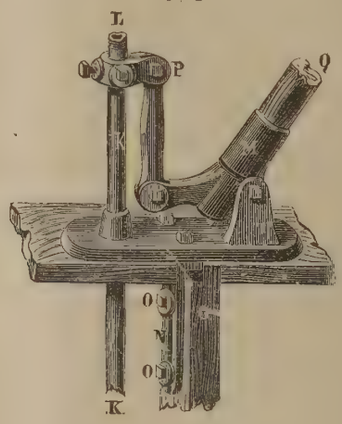


Fig. 2.

streets, which are among the things which cities are found willing to do. It would not be so very much beyond that of constructing the large sewers which great cities find necessary.

Factory Floors.

We are informed that a method of laying floors wherever great solidity is required, and which has obtained a wide application in France, consists in putting down the floor, not, as is usual, on sleepers, but in embedding the boarding in asphaltum. For this method many advantages are claimed, and its adoption is very general not only for factory floors, but for ground-floors generally in barracks, hospitals, etc.

A somewhat similar plan to this is reported by one of our contemporaries to have been employed in the construction of the floors in a new factory lately erected by Messrs. Bliss & Williams in Brooklyn, N. Y. Sleepers are employed, but instead of stretching between supports, they are solidly embedded in concrete. Upon these, planking is placed, each plank, as laid, being bedded in hot tar. The method of laying this floor may be of interest to our readers, and we reproduce the account given of it: The surface of the ground, after the top earth had been removed, was thoroughly smoothed and rolled. Four inches of concrete was then applied, and while this was soft, locust stringers were embedded in it, their tops being flush with the concrete surface; these stringers were spaced about 30 inches between centers. After the concrete had become perfectly hard and solid, 2-inch planks of Georgia pine were laid, each plank in turn being bedded in hot tar, which was spread on to the concrete as fast as the planks were laid and spiked. The result is described to be a floor on which the heaviest machines can stand in any convenient position without the necessity of any special foundations. It is, moreover, water-proof and rot-proof.

Honor to Distinguished Merit.—The announcement is made that the French Academy of Sciences has awarded an Extraordinary prize of 3,000 francs to Dr. William Crookes, in recognition of the eminent merit of his discoveries in molecular physics and radiant matter.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$60 00 @ — —
Pine, good	50 00 @ 55 00
Pine, shipping box	18 00 @ 22 00
Pine, common box	17 00 @ 18 00
Pine, common box, ⅝	15 00 @ 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	40 @ — —
Pine, tally plank, 1¼, 2d quality	35 @ 38
Pine, tally plank, 1¼, culls	28 @ 30
Pine, tally boards, dressed, good	28 @ 30
Pine, tally boards, dressed, common	22 @ 25
Pine, tally boards, culls, dressed	22 @ 25
Pine, strip boards, merchantable	16 @ 18
Pine, strip boards, clear	22 @ 25
Pine, strip plank, dressed, clear	33 @ 35
Spruce boards, dressed	20 @ 22
Spruce plank, 1¼-inch, dressed	25 @ 28
Spruce plank, 2-inch	35 @ — —
Spruce wall strips	13 @ — 15
Spruce timber, per M	18 00 @ 22 00
Hemlock boards, per M	15 00 @ 16 00
Hemlock joist, 2½x4, each	15 @ — 16
Hemlock joist, 3x4	16 @ — 18
Hemlock joist, 4x6	40 @ — 44
Ash, good, per M	40 00 @ 45 00
Oak	50 00 @ 85 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 75 00
Chestnut	45 00 @ 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black walnut, good to choice	85 00 @100 00
Black walnut, ⅝-inch	75 00 @ 85 00
Black walnut, selected and seasoned	110 00 @150 00
Black walnut counters, per ft	12½ @ 20
Cherry, wide, per M	85 00 @100 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 55 00
White wood, ⅝-inch	30 00 @ 45 00
White wood, ⅝ panels	35 00 @ 45 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 21 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	1 50 @ — —
Yellow dressed pine flooring	25 00 @ 30 00
Yellow pine girders	30 00 @ 40 00
Locust posts, 8 feet, per inch	18 @ 20
Locust posts, 10 feet	24 @ 25
Locust posts, 12 feet	29 @ 34
Chestnut posts, per ft	3 @ 3½
Basswood per M	25 00 @ 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	4 75 @	5 25
Up Rivers	7 25 @	8 00
Jersey	— — @	— —
Long Island	— — @	— —
Haverstraw Bay	8 25 @	
" " choice	8 75 @	
Favorite Brands	— — @	— —
Hollow Fire-Clay Brick	9 00 @	9 25

FRONTS.

Croton—Brown, per M.	10 00 @ 11 00
" Dark	11 00 @ 12 00
" Red	12 00 @ 13 00
Philadelphia	— — @ — —
Trenton	21 00 @ 22 00
Baltimore	38 00 @ — —
Clark's Ottawa White	25 00 @ — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	26 00 @ 27 00
" Glengarnock	24 00 @ 25 00
" Eglinton	23 00 @ 24 00
" American, No. 1	29 00 @ 30 00
" American, No. 2	27 00 @ 28 00
" American, forge	26 00 @ 27 00

	Store prices.	Cash.
Bar, Swedes, ordinary sizes	— 6 @	6¼
Bar, Swedes, nail-rod	— 6½ @	— —

LEAD—PER 100 POUNDS.

*German	— — @ — —
*English, common	— — @ — —
*Spanish	— — @ — —
*Foreign, refined	— — @ — —
*Bar	7 50 @ — —
*Sheet	9 00 @ — —
*Pipe	— — @ — —
*Domestic	5 75 @ — —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 70 @ — —
8d and 9d, common	3 95 @ — —
6d and 7d, common	4 20 @ — —
4d and 5d, common	4 45 @ — —
3d and 4d, light	5 20 @ — —
3d, fine	5 95 @ — —
2d, fine	5 95 @ — —
Cut spikes, all sizes	4 95 @ — —
Clinch nails, 1½ to 1¾ inch	5 95 @ 6 20
do. 2 to 2¼ inch	5 70 @ — —
do. 2½ to 2¾ inch	5 45 @ — —
do. 3 inch and longer	5 20 @ — —

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	9 50 @ 10 00
*I. C. coke, 10x14	7 50 @ 8 75
*I. X. charcoal, 10x14	11 50 @ 12 00
*I. C. charcoal, 14x20	9 50 @ 10 00
*I. X. charcoal, 14x20	11 50 @ 12 00
*I. C. coke, 14x20	7 50 @ 8 75
*I. C. coke, terne, 14x20	7 50 @ 8 25
*I. C. charcoal, terne, 14x20	8 50 @ 9 00

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 8¼ @ — 8½
Sheet, (open)	— 9 @ — 9½

SOLDERS.

No. 1	— 13½ @ — 14
No. 2	— 12½ @ — 13

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 @ 1 00
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown-Stone, Portland, Conn	1 30 @ 1 35
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Dorchester, N.B., Stone, rough, per foot	— — @ 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 @ 7 25
Chalk, per 100 lbs	— 35 @ — —
China Clay, per ton gold	18 00 @ 20 00
Chrome yellow, dry, per pound	— 12½ @ — 28
Lead, red American, per pound	— 8 @ — 9
Lead, white American, pure, in oil	— 9 @ — 9½
Lead, white American, pure, dry	— 8¼ @ — 8¾
Lead, white English, pure, in oil gold	— 9½ @ — 10½
Litharge	— 7½ @ — 8
*Ochre, Fr., dry, per 100 lbs	1 50 @ — —
Ochre, ground, in oil, per lb	— 6 @ — 15
Ochre, Vermont, per 100 lbs	— 75 @ 1 00
*Orange Mineral, English gold	— 9½ @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, per lb	— — @ — 25
Putty, per lb	— 2½ @ — 3
Spanish Brown, dry, per lb	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, per lb	— 8 @ — 9
Venetian red, per cwt	1 75 @ 2 00
*Vermilion, Chinese, per lb	— 85 @ — 90
*Vermilion, Trieste	— 70 @ — 75
*Vermilion, quicksilver, bags gold	— 60 @ — 62½
Vermilion, American, common	— 15 @ — 18
Whiting, per 100 lbs	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¼ @ — 9
Zinc, white French, in oil gold	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
do do	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

CEMENT—PER BARREL.

Portland (imported)	2 95 @ 3 25
Portland (American)	2 65 @ 3 00
Portland (Spanish)	2 50 @ 2 75
Portland (Lafarge)	3 20 @ 3 40
Portland (German, Bonner)	2 85 @ 3 25
Lime of Teil	2 20 @ 2 30
Lime of Teil, per ton	15 00 @ 18 00
Roman	2 75 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ — —
Rosendale	1 10 @ — —

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb.	— 1¼ @ — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16 @ — 18
Goat, " "	— 21 @ — 25

SLATE.

Purple roofing slate, per square	$6 00 @ 7 00
Green slate	7 00 @ 7 50
Red slate	10 50 @ 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 @ 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 @ — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50 @ 4 00
Nova Scotia, blue	3 50 @ 3 75
Calcined, Eastern and city, per bbl	— — @ — —
Calcined, city casting	— — @ — —
Calcined, city superfine	— — @ — —

LIME—PER BARREL.

State, common	— 90 @ — 95
" finishing	1 15 @ — —
Rockland, common, cargo rate	1 00 @ — —
" finishing	1 25 @ — —
Ground	1 60 @ — —

Add 25 cents to above figures for yard rates.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¼ inch.	$ 84	—
2.6 x 6.6	1¼	1 18	—
2.6 x 6.8	1¼	1 24	—
2.8 x 6.8	1¼	1 30	—

DOORS, MOLDED.

Size.	1¼ inches.	1½ inches.	1¾ inches.
2.0 x 6.0	$1 54	—	—
2.6 x 6.6	1 90	2 41	—
2.6 x 6.8	1 96	2 43	—
2.6 x 6.10	1 98	2 51	—
2.6 x 7.0	2 02	2 61	—
2.8 x 6.8	2 02	2 61	3 20
2.8 x 7.0	2 11	2 71	3 36
2.10 x 6.10	2 23	2 82	3 55
3.0 x 7.0	2 33	3 06	3 75

OUTSIDE BLINDS.

Up to 2.10 wide, per lineal foot	25 @ —
Up to 3.1 wide	27 @ —
Up to 3.4 wide	30 @ —

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 20 @ — 35
St. Domingo, crotches, fine	— 25 @ — 50
St. Domingo, logs, small	— 5 @ — 8
St. Domingo, logs, large	— 20 @ — 30
Frontera, Mexican, large	— 11½ @ — 16
Frontera, Mexican, small	— 8 @ — 10
Other Mexican	— 8 @ — 14
Honduras	— 10 @ — 15

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ @ — 6
Rio Janeiro, good to fine	— 5 @ — 8
Bahia, ordinary to good	— 2 @ — 6½
Bahia, good to fine	— 4½ @ — 8
Honduras, per ton	10 00 @ 20 00
Satin Wood, per foot	— 15 @ — 60
Tulipwood, per lb	— 6 @ — 12½
Lignumvitæ, small, per ton	25 00 @ 65 00
Lignumvitæ, large	25 00 @ 50 00

CEDAR.

Cuba, per superficial foot	— 10 @ — 12½
Mexican, small	— 8 @ — 10
Mexican, large	— 10 @ — 14
Florida	— 30 @ 1 50

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

GENERAL REVIEW OF THE MARKETS.—No important change in the condition of the markets has transpired during the past month, and with the exception of a slight decline on a few grades of goods, prices have been well maintained. Consumption has been large, both from local and out of town sources, with supplies sufficient in all cases to meet every call. The position of the markets at this writing is very firm. Outside of the articles of building proper, the greatest decline that has been witnessed has been in the metal markets, notably iron, which has fallen off to a remarkable extent. This decline is but the natural sequel to the recent unhealthful inflation of values—delusively called the "boom."

THE MARKETS IN DETAIL.—In the brick market business has shown some irregularity, with the advantage mainly in buyers' favor. This was due to liberal arrivals and a constant supply afloat over demand, leading to more or less competition in order to secure customers.

In the lumber market the local consumption has been good—indeed, quite full, and there has been a considerable call from outside sources.

In the lime market there has been no change of a decided character. A good demand has been shown for fresh arrivals, and values have been pretty well sustained, with advices at hand said to indicate light receipts for some little time to come.

In the lath market the situation may be said to be nominal, with $1.50 per M. the ruling rate at present.

In the hardware market much dissatisfaction and disappointment over the general condition of trade has been shown among dealers. Orders that have been received have been small, and only for goods absolutely required, buyers seeming to prefer to await further developments. Even on what is considered the regular trade demand, the amount handled has proved small, and been confined positively to standard goods. Values have been unsettled.

In the metal markets the decline noted in our last has continued in a remarkable degree, as may be seen by a comparison of our present quotations with those of last month, some grades having fallen off nearly a third. Scotch pig has found only a moderate demand during the month, and the tone of the market developed weakness, with some sales made from vessels at less than our figures. American pig has not received much attention—indeed, it has been under quite decided neglect, but sellers refused to offer with freedom or to make any decided shading on cost. Manufactured iron has found only a moderate, uncertain sale, and the market has lacked tone.

In the lead market domestic pig has found a rather slow and uncertain sale, as buyers and sellers are apart in their views and business confined to parcels required for immediate and absolute necessity. Manufactured lead has been quite firm. Tin in pig has met with a pretty liberal sale, and the reduction thus made in the amount offering has imparted a somewhat more hopeful feeling. Tin plates have had a very unsettled market, and no special activity has been shown.

In the paint market dealers continue to claim a good, healthy jobbing movement, with a tendency to increase rather than diminish, and the call covering nearly all grades of stock. On the wholesale market business has been fairly active.

Hints on the Use of Disinfectants.

As we are again approaching the warm season of the year, it may not be amiss to place before our readers a few practical hints concerning disinfectants, and the proper method of using them, a little in advance of the time when their need is most seriously felt. It is our intention here to confine our remarks to those disinfectants that are best known and most commonly used, since these are not only the cheapest, but, when properly used, the best. There are great numbers of disinfecting liquids, powders, etc., patented and otherwise, sold under trade names, for which special virtues are claimed by their makers and venders; but while we do not wish to be understood as condemning such articles indiscriminately, or as denying that many of them may really be excellent for their intended purpose, we think it quite safe to assert that whatever merits they possess they owe to the fact that they contain one or the other of the well-known agents we describe below, among their constituents.

It is a safe rule to follow, not to use a disinfectant of whose composition you are ignorant. The commonest disinfectants are, sulphur, the hypochlorites, carbolic acid and its compounds, and metallic salts, chiefly those of iron and zinc. This enumeration, while it is not by any means complete, is nevertheless sufficiently so for all practical purposes, since those that are not included in this classification are either of questionable value or too expensive for general use.

All the substances above named are of real value for disinfecting purposes, though they differ in the rapidity and thoroughness of their action, and in their adaptability under different circumstances. The conditions under which disinfectants are called for vary greatly, and as a consequence, the best agent for one class of cases may be quite unsuited for another.

Stated in the most general way, there are three different conditions under which disinfectants are required: (1) The purification of an infected atmosphere; (2) the purification of sewers, gutters, cesspools, drain-pipes, water-closets, and similar places where putrescible matter may accumulate in quantity; and (3) the disinfection of clothing, bedding, utensils, etc., used in and about the sick chamber.

The purification of an infected atmosphere, as of a ship, house, hospital, etc., can be effectually accomplished only by the use of some disinfectant that shall give off a gaseous element that may pervade the entire space and penetrate into every nook and corner. For this duty, a volatile agent is called for, and the first three substances named in our list are the most generally employed—namely, sulphur, hypochlorite of lime (commonly called chloride of lime), and carbolic acid.

In every such case, the entire space or apartment should be effectually closed against the escape of the purifying agent, and the atmosphere should be thoroughly saturated with it for at least twenty-four hours. The sulphur should be burned in open vessels, the chloride of lime acidified with dilute sulphuric acid, and the carbolic acid left standing about in vessels open to the air. When the thorough impregnation of the atmosphere has been effected, it will be advisable to thoroughly scrub the wood-work with a one or two per cent solution of one of the metallic salts, preferably the chloride of zinc. Of the three disinfectants named above, sulphur and chloride of lime are to be preferred as more certain in their action, since carbolic acid of commerce is notoriously unreliable in quality, and the very pungent and persistent odor that even a trifling quantity of it leaves behind, is apt to create a false sense of security.

The purification of sewers, gutters, kitchen sinks, drain-pipes, water-closets, etc., is best accomplished by means of the metallic disinfectants, of which the best known and the most effective are the salts of zinc and iron; and as the best known representatives of this class of compounds we may name the chloride of zinc (Burnett's Fluid, also known by the trade name of No. 1 Disinfectant), and sulphate of iron (copperas). The action of these compounds is not very unlike, as they act on the sulphur and ammonia compounds to which the offensive odor of decomposing animal and vegetable refuse is to be chiefly ascribed, and bind them in the form of solid and inodorous combinations, and also act on the albuminous constituents of such refuse to coagulate them, and thus hinder their further decomposition. Of the two disinfectants named as best adapted for this form of disinfection, green vitriol has been and is most commonly used, because of its cheapness; but the zinc salts is much more prompt and effective, and if its price could be brought low enough to enable it to compete with that of copperas, it should be preferred to the latter. Of late, it may be added in this connection, there have been decided advances made in the production of cheap zinc salts, by patented processes for utilizing certain waste products of the galvanizing works; and it is affirmed that zinc salts (chloride or sulphate) can now be supplied at prices considerably below those that have hitherto ruled. We should add here that neither carbolic acid nor chloride of lime can be used to good purpose to any large accumulation of offensive matter—as, for example, in sewers, gutters, cesspools, water-closets, etc., for the following reasons: The quantity of carbolic acid required for the task of purification would be so great as to place its use out of the question on the score of expense. And the action of the chloride of lime will be speedily checked by the alkaline character of such bodies of decomposing refuse.

For the disinfection of the sick chamber, the bed linen, towels, and necessaries there in use, zinc salts are greatly to be preferred to any others. The chloride of lime and carbolic acid are unendurable by reason of their disagreeable and irritating odor, while the zinc salts is odorless. A sheet or towel suspended in the room, and from time to time dampened by immersion in a dilute solution of this kind, will be generally found sufficient to keep the atmosphere of the room quite free from disagreeable odors, by reason of the air currents which the evaporation of the moisture establishes, bringing the air of the chamber in contact with the disinfectant.

The rules prescribed last summer by the National Board of Health, and of which we give below a brief summary, will be found to agree substantially with the suggestions contained in the foregoing. The National Board recommends for fumigation (that is, the purification of an infected atmosphere), roll sulphur; for cesspools, sewers, etc., sulphate of iron, (copperas); and for clothing, bed linen, etc., zinc salts.

Dr. J. Lane Natter, of the British Army Medical Department, who has made a most careful and thorough experimental study of the comparative value and merits of the disinfecting fluids and powders most widely known and used, has reached substantially the same results. He defines a "disinfectant" to be an agent which is capable of destroying, by chemical action, not only the decompositions which are casually connected with the presence of organisms, but the organisms themselves. It is only under such a condition of things, he asserts, that we can say with any degree of certainty that the contagia of communicable disease are deprived of their specific action; and anything short of this will not, in the true sense of the term, be a destructive agent. The object of his comparative experiments, above alluded to, was therefore to ascertain by actual test the relative power of various agents, not only for correcting the putrefactive odor of putrefying and decaying animal or vegetable substances, but also in subjugating the development of bacteria. To this end he has placed on record a detailed and minute microscopic examination of the effect produced on a measured quantity of beef infusion (a very putrescible liquid), swarming with bacteria, by adding to it certain known proportions of various disinfecting fluids and powders. The substances subjected to trial were the following: Carbolic acid, chloride of lime, chloralum liquid (a solution of chloride of aluminum), Condy's fluid (a weak solution of permanganate of potassa), Sanitas (a liquid said to be derived from turpentine by the combined action of steam and air), Burnett's fluid (chloride of zinc), and others, which, as they are simply mixtures of the others, need not be specially named. Without entering into the details of the numerous experiments, which would unduly lengthen our article, we will briefly state the author's results. He places the various agents named above in the following order of merit:

1. *Chloride of Lime* destroyed the putrefactive odor, and the bacteria themselves.
2. *Chloride of Zinc* (Burnett's fluid, No. 1 disinfectant) acted similarly.
3. *Carbolic Acid* subdued the offensive odor, but did not check, though it subdued the activity of the free bacteria.
4. *The Terebene Preparations* (and Sanitas) destroyed the odor and precipitated the bacteria, but left some free.
5. *Permanganate of Potassa*, similar to the above.
6. *Chloralum* (and a number of other compounds with special trade names) did not affect the odor save to a small extent, while they only slightly diminished the activity of the bacteria.

From the foregoing, our readers will be able to judge for themselves what disinfectants to use under the various circumstances that call for them.

Good Time for the Brick Makers.

The general improvement of the business of the country came a little too late last year to give any remarkable impulse to building operations; but there is every indication that the season into which we are entering will witness the undertaking of building operations on a scale of great, if not of unprecedented magnitude. The outlook, therefore, for the building material men is a most promising one. The brick makers especially are taking time by the forelock, and preparing for a busy season in anticipation of the demand for an unusually large product. From the Hudson we hear reports of the most encouraging kind respecting the brick industry. In view of prospective demands, all the available yards, many of which have laid idle for years, will now be run to their utmost capacity, and the total product, it is safe to predict, will be greatly in excess of that of any previous year.

The magnitude of the brick industry that has grown up along the Hudson river will be appreciated from the statement that during the present season there will be at least 175 yards in operation between Tarrytown and Troy, the productive capacity of each of which will vary from 20,000 to 150,000 bricks per day. Taking 50,000 as fairly representing the production of a yard, averaging the large and small ones, and making a fair allowance for loss in burning, handling, bad weather, and other incidents of loss, the capacity of the Hudson river yards, for a season of say seven months, will be over a billion bricks. In Haverstraw Bay alone, there are now no less than 40 yards, and at Verplank's and in the neighborhood of Kingston there are many heavy firms engaged in the business.

The contract for bricks for the Hudson River tunnel has been awarded to one of the firms along the river (J. I. & R. Washburn, of Glasco). They will be called on to supply 24,000,000, at the rate of 8,000,000 per year.

THEY HAD ALL HAD IT!—J. W. Hughes writes to a Montreal medical journal as follows: "Inspected a house in the country at the request of the attending physician, as the general health of the family had been bad for a long time, they having suffered from a class of complaints that would indicate bad drainage, etc. Found under the floor a wooden drain with rotten cover, and soil saturated with sewage; trap on water-closet non-effective; water-closet foul; situation very bad; ventilation so arranged as to poison the room above it, a sleeping apartment occupied by a young man suffering for a long time from general ill health. No trap on kitchen sink; water supply cistern connected directly with the sewer without traps in the overflow pipe. On my reporting the latter fact to the family expressing my surprise that they had not all had typhoid fever, they exclaimed in chorus, 'Oh, we have all had it!'"

Home Department.

House Drainage.

(*Concluded from Page 91 of April Number.*)

Now, for the most serious part of the problem before us, we must consider water-closet and soil-pipe arrangements. The water-closets most in use are of two kinds, pan and valve closets. The former has an iron "container" below the basin or receiver. This iron vessel is hard to keep clean. In the valve-closet, a portion of water is detained above the valve, which is quite an

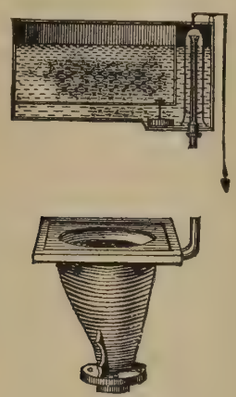


Fig. 10.

advantage; and there is no large container. The valve closet is decidedly the best, but also the most expensive. Simplicity is so desirable in such fixtures (as, indeed, in everything else), that good authorities are inclining towards a return to the oldest form of the "hopper" immediately over the trap.

Fig. 10 gives a view of a closet which carries out

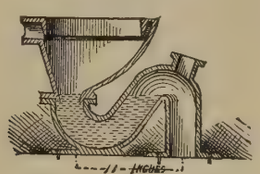


Fig. 11.

this idea very well, as does also the closet shown in Fig. 11. Whatever form or plan of water closet be used, it is of great importance to provide an abundance of water for flushing it. Neglected water-closets left to accumulate obstructive materials of any kind, will in time grow very foul—sometimes even worse than the average open privy.

Soil pipes are now mostly made of iron. Enameled iron is the best material, with caulked lead joints. Four inches will not be too large for a house of moderate size; 4½ or 5 inches diameter will be enough for the largest mansion or hotel. All sanitary engineers now agree that it is a serious mistake to make drain pipes too large; a drain 6 inches in diameter will suf-

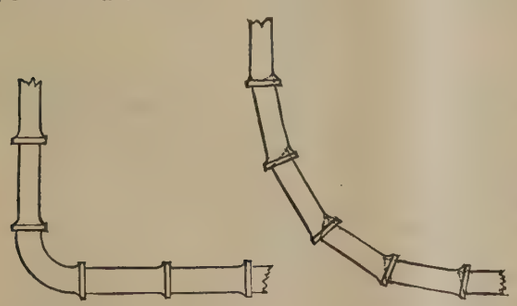


Fig. 12. *Fig. 13.*

fice for more than a hundred houses. In a large pipe, but partially filled, the flow must be sluggish; the same amount of material in a smaller pipe nearly full, will move rapidly through it, and thus avoid stagnation. For changes of direction and entrance of branches, right angles must be avoided, and as few inclined joints should be made as possible. Figs. 12 (right) and 13 (wrong) will illustrate this principle.

Every soil pipe should have a trap at or near its junction with the drain or sewer into which it discharges. It is well also for this to be aided by a flap-

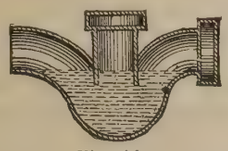


Fig. 14.

valve, to assist mechanically in the exclusion of sewer air. Some recommend two traps in this position. Such a trap, or traps, should, when possible, be outside of the house, and accessible for inspection. This accessibility, it may be here remarked, should be provided for in the construction of all drains and drainage pipes whatever. A plan of the house plumbing and drainage should be made when it is built, and kept for reference at any time. The absence of such a plan may sometimes cause great inconvenience and damage.

House drains running under or upon the ground should be made of salt-glazed earthenware. It is better for them to be made of iron, and suspended from the lowest floor. If on the ground, they should be laid with great care, upon a bed of concrete, or at least with good "clay puddling," and the joints secured with the best cement. Sinking of the ground under a drain, unless effectually provided against, may result in broken joints, with leakage of sewage under or near the house, saturating the ground in the most injurious manner. No drain should ever run under a house when this can at all be avoided.

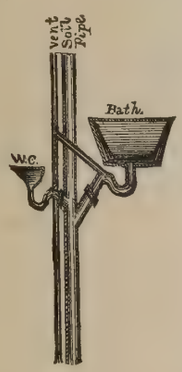


Fig. 15.

Next, ventilation must be supplied for all the house-drainage system. This is needed, first, for each trap; secondly, for the soil-pipe; thirdly, for the drain or sewer into which all the house drains empty. Every trap should be ventilated from the top of its outer bend. Its vent should not go into the soil pipe or its ventilating pipe, but should have a separate air pipe. All the traps of the house, however, belonging to baths, lavatories, and cistern overflows, may be vented by branches connected with the same pipe, if this be quite disconnected with the water-closet system. The only satisfactory way to ventilate a soil pipe is to continue it all the way up above the roof; best to a hight of 10 or 12 feet above the eaves, and always in a direction clear of all windows. Rain-water pipes must not be used to ventilate soil pipes or drains. When connected with these, they are of no use in this way during storms, and, at other times, opening just at the eaves, they may, when so connected, take bad air into upper windows. Some have recommended an open trap (covered by a grating) for ventilation at the foot of the soil pipe (see Fig. 14). Better than this is an air pipe, which need not be more than 2 inches in diameter, ascending from the trap at the foot of the soil pipe to or above the highest part of the roof. This U-shaped arrangement of soil pipe and foot-ventilating pipe together has been found to work extremely well. The foot pipe may answer for receiving all the water-closet trap ventilators of the house. For additional air protection, a small vent may pass from the water-closet immediately under the seat. This must not enter the soil pipe or its ventilator, but it may quite safely be led into and carried up through the flue of the kitchen chimney. Ventilation of a soil pipe directly into the kitchen chimney is sometimes arranged for, but it is not advisable. Downward draughts (particularly when for a time the fire is out) may mingle impure air from the soil pipe with that of the kitchen. If the ventilating pipe goes through the flue and up the whole hight of the chimney, there is no considerable risk of harm. As a rule, however, no pipe containing foul air should be allowed to go through a house when it is possible for it to ascend or descend outside of the house. The chance of leaky joints within a house is

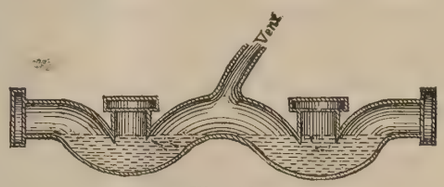


Fig. 16.

too serious to be permitted when avoidable. If there be such a pipe carried through a house, it ought to be of metal (preferably enameled iron), not of earthenware, or, worst of all, of wood. Arrangements intended to promote a healthy state of things may sometimes, through unskillfulness or negligence, have the very opposite effect.

The plan exhibited in Fig. 15 of ventilating a bath-escape trap and a water-closet trap by the same pipe, is not perfect, although it is much better than some methods in common use. Experience shows it to be unwise ever to have a water-closet immediately communicating with a bed-chamber. The length of time spent in sleep, often without much renewal of the air, and, it seems probable, a greater susceptibility than in the waking state to depressing causes, makes the danger of blood poisoning greater under such than under any other circumstances, if contamination of the air exists. When a water-closet is not well supplied with window ventilation, this may be supplemented, or in part substituted, by a pipe going upward through the roof, under whose expanded lower opening a small jet of gas is kept constantly burning.

So far, we have considered the ventilation of traps and soil pipes only in view of their air purification. But there is another occasion for it. When two or more traps, one over another, connect with the same soil pipe, the discharge from an upper one may, in passing downward, suck (or siphon) out the water which seals a lower one, and thus leave it empty. This, of

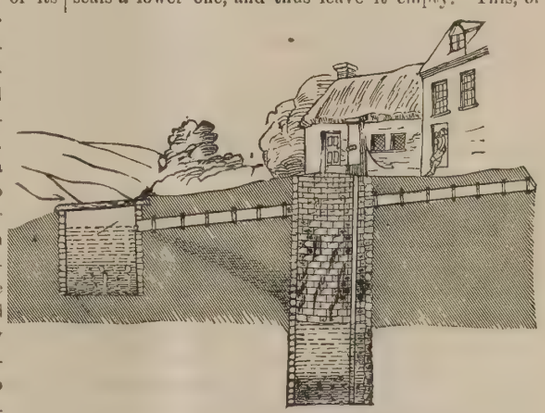


Fig. 17.—How People Drink Sewage.

course, allows the ascent of foul air, passing the lower trap, and such a possibility is not at all a matter of theory merely, but of frequent, actual occurrence. When air is admitted, not only through the open end of the soil pipe, but also by a vent above each trap, such a siphoning and unsealing cannot occur.

Supposing, then, that we have arranged to convey

safely out of a house all its drainage, what are we to do with it? First, in towns; privy wells ought never to be considered allowable, even in closely built villages, much less in populous cities. They cannot often —certainly they cannot generally—reach to flowing water, or to an entirely pervious sandy bottom. Therefore they will gradually saturate the earth, contaminating the "ground-water," and, in consequence, more and more the ground-air. One fact in regard to air-movement we have not yet alluded to, namely, that in all but the warmest months of the year, the whole of an inhabited house, and through the year, that part heated by the kitchen fire, is, on account of its warmth being greater than that out-of-doors air, drawing, sucking in air from the surface of the ground, and from the ground itself around it.

Thus sewer-air (which, properly speaking, means all air spoiled by human waste) finds access to houses whose interior arrangements are, in themselves, without fault. If this be true, so long as the earth-closet system, or nightly removal by a pail system (both very good, but not yet made convenient for large communities in this country) cannot be maintained, we have no resort but connection with the common sewer. Opposition to this has grown out of numerous cases of harm done by the escape of sewer air into houses through defective plumbing. But no bad plumbing should be allowed; and the air of the largest sewers may be kept innocuous by proper construction, good slope, ample water supply, and ventilation. The old style of immense square-built brick sewers is an abomination which ought now nowhere to be tolerated. If made round or egg-shaped (with the small end downward), of a size not large enough for stagnation, and of impermeable material, properly cemented at the joints, they will need then only abundant flushing and numerous air vents to make them safe throughout. The connection of house drains with town sewers must be very carefully guarded; the double trap (Fig. 16), with screw plates for inspection and a ventilating pipe, being now the most approved arrangement.

In country houses, whose owners can afford carefulness for health's sake (and who that lives in a house of his own, cannot and ought not?), the same essential principles are applicable as in city residences. The most common method of rural house-drainage, is to convey waste underground to a cesspool, at a variable distance—the greater the better—from the house. By a cesspool is generally meant a large and moderately deep well, which, if used, ought to have a removable cover for examination and emptying when needful. It is, with advantage, divided into two parts by a grating, separating solid from liquid waste. A good way of preparing the former at proper intervals of time for cleaning out, is to throw over it a quantity of earth. This makes its removal less unpleasant, and affords by the mixture a very serviceable manure. The liquid portion may be directly applied to the ground; best by irrigation through sub-surface tile pipes, open at a portion of their joints, to allow of the escape of the drainage into the earth. There are some situations which do not admit of any such distribution of waste material; for instance, at the sea-shore, where hundreds of cottages, as well as boarding-houses for summer occupation, sometimes spring up in a single season.

For the evacuation of waste wells and cesspools in town or country, but especially in cities, the odorless pneumatic system is undoubtedly a great improvement. After all, however, the ideal method is the return of all human waste, as soon and as conveniently as possible, to the ground. Nature's own disinfectants are the earth and growing plants. Together, these are perfect in their action, and they admit, satisfactorily, of no substitutions; nor need any one be afraid of this effective transforming process—this alchemy of nature, when sewage passes through (not lying stagnant upon) the soil on which there is abundant vegetation. The Craigentinny meadows, near Edingburg, derive their luxuriance from sewage irrigation. At Clichy, near Paris, five thousand acres of barren sand were, by the sewage of Paris, converted into fertile fields and gardens. A manufacturer of perfumes chose this favored spot for the culture of his aromatic herbs. The finest mignonette of Covent Garden market, London, has long been grown upon sewage-watered soil. Among the *Alpes Maritimes*, ground fertilized chiefly with waste of human habitations, produces, for the uses of the perfumers, an abundance of roses and violets.

Miscellaneous and Advertising.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

A monster floating railway station, capable of carrying trains across the English Channel at the rate of 14 knots an hour is proposed. Each train, according to the scheme, would provide accommodations for 2,000 passengers, which would require 60 or more railway carriages.

A compound pumping engine, having a daily capacity of 5,000,000 gallons, is now being constructed by the Knowles Steam Pump Works, of New York and Boston, for the New Orleans water-works. The engine will combine all the latest improvements, and will be highly finished.

The well-known Clayton Steam Pump and Air Compressor Works, at 14 and 16 Water street, Brooklyn N. Y., have, within the past six months, enlarged their shop, increasing its capacity fifty per cent, and for some time past have been obliged to employ another shop exclusively on air compressors for mining purposes.

A patent has recently been taken out for making tooth-wheels of leather in place of metal. The advantages claimed for them are that they have a much quieter and more elastic run, are extremely durable, and require no lubrication whatever. They are prepared from raw, untanned buffalo hides, thoroughly cleansed from all hair, etc.

There has recently been put on the market by a house in Leipsic, colored inks which may be used for writing labels on glass, porcelain, ivory, marble, mother-of-pearl and metal. The writing is done with a goose-quill, and, when dry, adheres so firmly that it cannot be removed by any liquid. Four different colors are made —black, white, red and blue.

The Tay bridge is to be rebuilt. The North British Railway Company has made application to Parliament for the necessary powers to reconstruct the ill-starred bridge at a lower level, and also for authority to build a new bridge alongside the present bridge, and laterally connected with it. The cost of rebuilding the structure is estimated at about $325,000—not such a costly undertaking after all.

Attention is called to the superior sheet-iron roofing manufactured by the Porter Iron Roofing Co., of 101, 103 and 105 West Front st., Cincinnati, O. Thorough trials have shown the advantages of this kind of covering for roofs, both as to durability and ultimate economy. Those contemplating building would do well to send to the above-named company for their descriptive circular and estimates.

B. F. Sturtevant is employing 150 workmen, full time, at his extensive blower manufactory at Jamaica Plain, Mass., (office and warehouse, 72 Sudbury street, Boston). He turns out about 200 blowers a month, nearly half of them weighing 6 tons each. With the additions lately made to his factory, it now occupies an acre and three-quarters of land. He does all his own boiler work, as well as brass and iron casting, and is now preparing to make his own steel castings, in order to insure their perfect reliability.

That the sanitary question, so far as the water-closet system is concerned, has been thoroughly solved by Messrs. Wm. S. Carr & Co. in their "Defiance" water-closets, the abundant testimony of those using them shows. Thousands of buildings, both public and private, are supplied with these excellent closets, and we have yet to learn of an instance where they have failed to give satisfaction. They render the escape of sewer gas impossible, and are cleanly and not liable to get out of order. The manufacturers are at 110 Center street, this city.

While the question of the subdivision of the electric light remains an absorbing topic of interest, its practicability for large uses has already been too thoroughly demonstrated to need any argument in favor of its employment for lighting streets, public squares, factories, machine shops, halls, theaters and other like places. We say that no argument is required to show its advantages for such uses, because thorough and long-continued trials have proved its great value. Among the most successful in this field have been the Fuller Electrical Co., of 33 Nassau street, this city, who, having control of some of the most valuable patents in the market—Fuller, Keith and Gramme—have been able to show very effectively how much this system of lighting was really capable of. A most striking illustration of its thorough practicability has been its employment in Madison Square Garden; but this is only one of the numerous places in which the Fuller Company have placed it, with the best and most economical results.

Design for a $1,500 Dwelling.

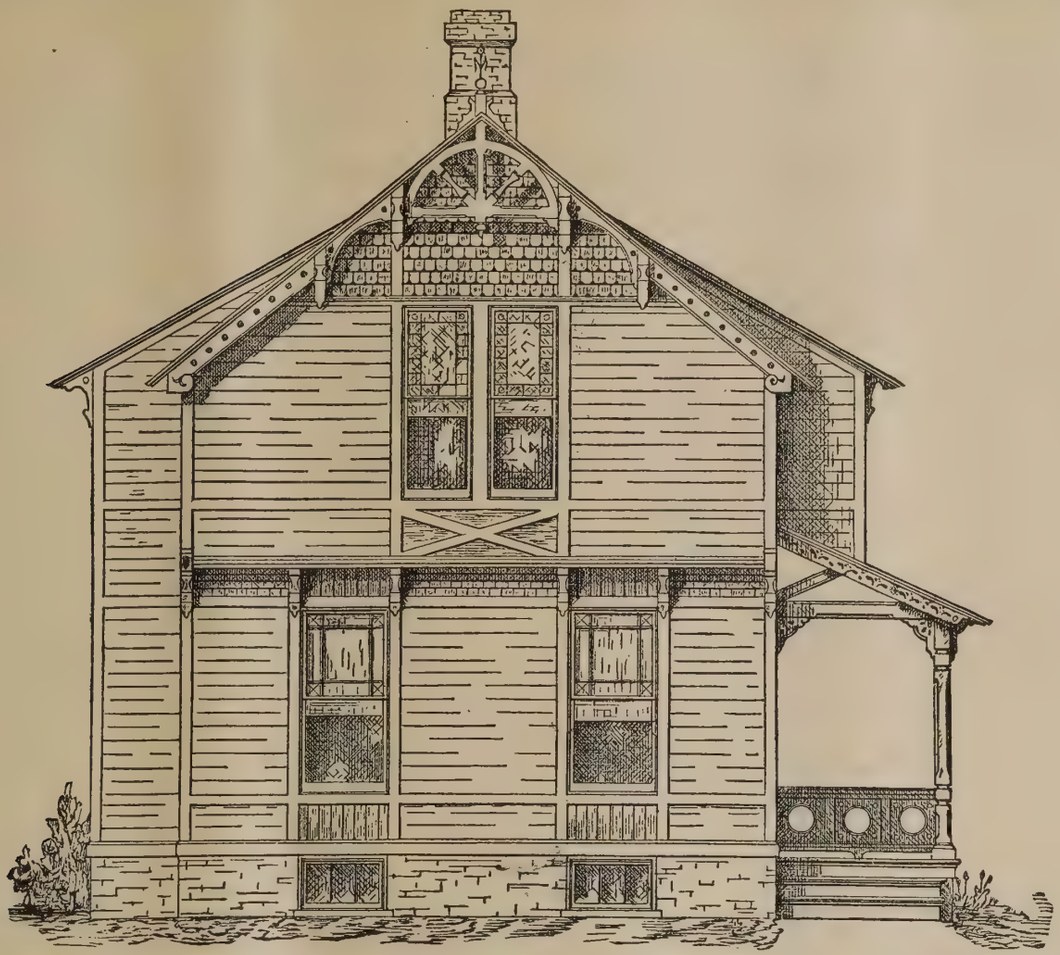
The design illustrated this month, besides being as to its exterior one of real architectural beauty, is in its interior arrangement admirable to a degree seldom obtained in houses of its price, the aim of the architects having been to so design it as to bring it within the means of that large class of people who wish to build cheaply and still not sacrifice comfort, convenience or effect to their forced economy.

All the rooms of this house, as may be seen by the plans, are commodious, and open directly into the hall (a particularly advantageous arrangement). There is ample closet room, and the position of the chimneys enables a fire-place to be put in every room, although there are but two chimneys.

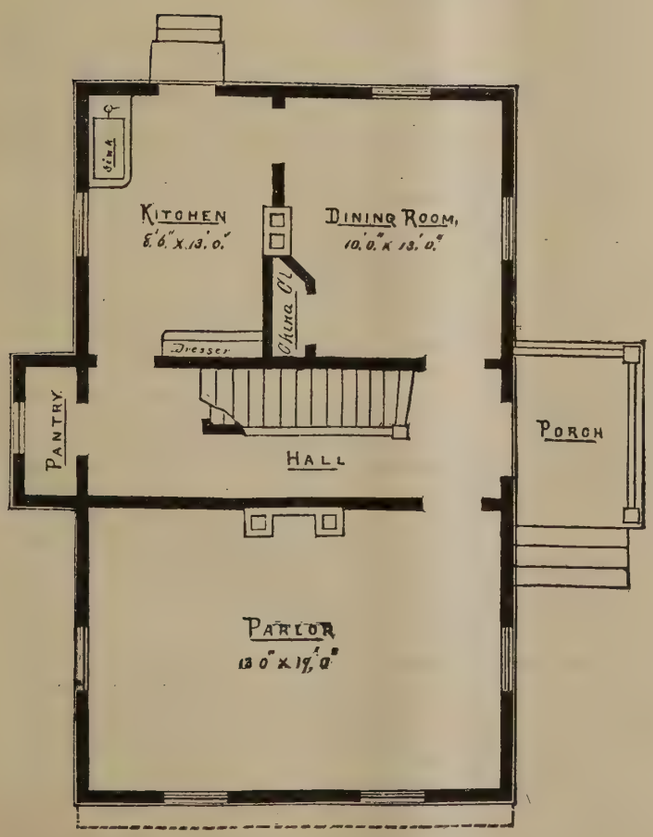
The details, though simple and of necessity regulated by the amount of money intended to be expended, are of a character to lend to the building a high degree of ornament and picturesqueness. The architects have in this design endeavored to secure a dwelling, which, for convenience and general homelikeness, shall vie with the more pretentious structures on which a greater sum of money has been spent. Careful attention has been given to the construction of the house, that, by unnecessary angles being all done away with, no waste of material either outside or inside shall occur. The building is first-class in every respect, and its great beauty and admirable arrangement have only been secured by the most careful study of every detail.

The timber used in the building is of hemlock, and of the following scantling: Sills, 4 × 6 inches, halved together at angles; posts, 4 × 6 inches; studs, 2 × 4 inches, set 16 inches from centers; floor joists, 2 × 10 inches, 16 inches from centers; plates, two 2 × 4 inches spiked together; rafters, 2 × 6 for pitch, crowed on to plate, and set 20 inches from centers; girders in cellar, 6 × 8 inches, supported by 6-inch chestnut posts, set on flat stones. The foundation is of stone, laid up in cement. The roof is shingled. The chimneys are of hard brick. The entire building, outside and inside, is painted in two coats.

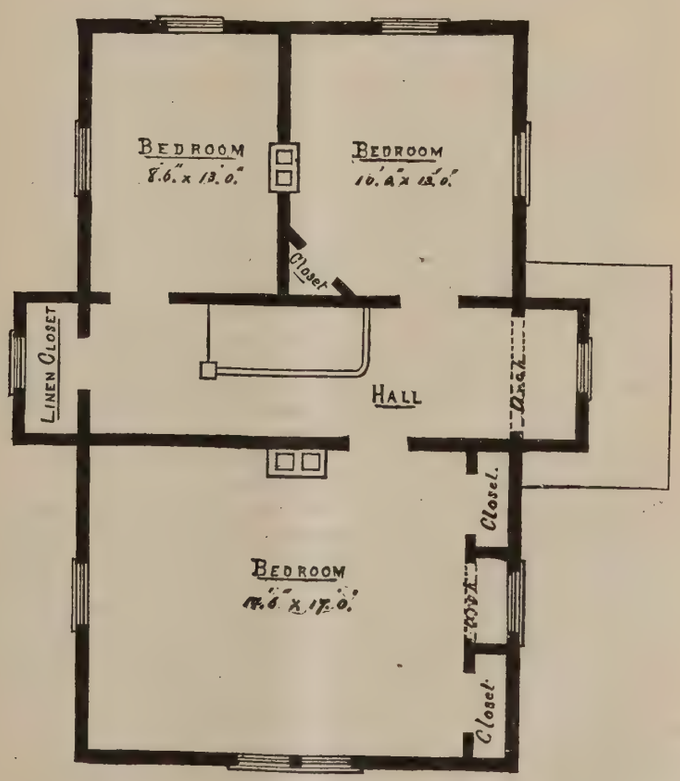
This house is the design of Messrs. Clarence W. Smith and Augustus Howe, Jr., of 7 Warren street, this city, and it is gratifying to state that it received the first prize offered in competition at the Fair of the New Jersey State Agricultural Society, at Waverly, last fall. The house was then estimated at $1,000, but the recent rise in the price of building material renders it necessary to increase this estimate about a third, making the estimated cost at the present time $1,500, at which sum the house could be built in good style in the vicinity of New York city.



DESIGN FOR DWELLING COSTING $1,500.



FIRST STORY



SECOND STORY

Enameled Bricks.

As an offset to the nearly perfect fire-proof qualities of well-made bricks, which are universally acknowledged, there are certain objections to their employment, partly æsthetic and partly relating to the material itself, which are worth attention.

Without noticing the æsthetic objections, which relate chiefly to the difficulty of employing bricks for decorative purposes, the objections which are more serious reside in the fact that bricks are very absorptive of moisture, and that in the atmosphere of cities the combined effects of soot, dust and moisture, causes them to become in time permanently discolored and unsightly. If these objectionable features could be overcome—if, in other words, bricks could be produced capable of subserving the requirements of decorative architecture, and be at the same time non-absorbent of moisture and grime, bricks would be deserving of being placed in the front rank of building materials. But to do away with the material objections advanced is the difficulty. Paints have been applied, but they only afford a temporary relief, and must frequently be renewed. The problem is to produce a brick that shall be fire-proof, moisture-proof, dirt-proof, and cheap..

The nearest approach to such a desideratum, it seems to us, has been made by the manufacturers of what are known as "enameled bricks," which have during the past few years been very widely used, and which seem to be becoming exceedingly popular, and, we believe, deservedly so. The enamel is only put on the best quality of face bricks, and the enameled surface is as smooth and homogeneous as porcelain. It is inseparable from the brick itself, as the substance of the enamel is fused in the intense heat of a kiln, and penetrates into the porous clay, and the finished enamel is so hard, and at the same time so tough, that a nail driven with an enameled brick will leave neither scratch nor indentation on its smooth surface. The enamel renders the bricks impervious to moisture. Any desired colors can be made by suitable admixtures of mineral substances to the crude enamel, and after the thorough vitrification which it undergoes in the kiln, these colors are manifestly as permanent as those of porcelain, and none of the ordinary agencies of wear can permanently mar or soil them.

In producing this enamel, we are informed that china-clay, flint (quartz), and feldspar are used to make the body of the composition, to which certain fluxes and coloring matters are added, as may be required. The industry of making enameled bricks is not more than three or four years old, but has already grown to considerable proportions in our neighboring city—Philadelphia.

Changes of Flour in Becoming Bread.

In popular use we employ the word "bread" to qualify loaves which are served in slices. The rolls are much smaller. Both consist alike of crumb and crust; the crumb is made up of a multitude of cells of thin walls containing carbonic acid gas, the product of fermentation in the dough. These walls of the cells contain both gluten and starch, and traces of dextrine and sugar. As a consequence of the treatment of water and the application of heat, the starch grains, which, in their normal condition, are little sacks filled with minute granules of starch proper, have been swollen and ruptured. Starch similarly treated by itself, as in the preparation for stiffening linen in the laundry, when dried in a thin layer upon glass plate, for example, is transparent, and presents a glazed surface. When this glazed material is removed with a knife blade, it is seen to be stiff and horny. The gluten, which is mixed with it in the crumb of bread, and which may be conceived to be continuous, however thin throughout the wall of the cell, has been, by the process of baking, dehydrated—that is, the heat to which it has been subjected has driven out a certain amount of water, which chemically sustains something like the same relation to the gluten, from which it has been expelled, that the water, expelled by heat from alum crystals, sustains to the original body of alum. This is the condition of the gluten from the crumb in the interior of the loaf at the instant of its removal from the oven. On drying, it abstracts the water from the starch, with which it is coated or intimately mixed, as the roasted alum absorbs the water that is sprinkled upon it. The starch, by this process, being dried and stiffened, gives its support to the walls of the cell, and renders the texture of the stale loaf more firm than that of the fresh loaf.

New Publications.

Saws: History, Development, Action, Classification and Comparison of Saws of all Kinds. With Appendices Concerning the Details of Manufacture, Setting, Swaging, Gumming, Filing, etc.; Tables of Gauges, Log Measurements; Lists of Saw Patents, and other valuable information. By Robert Grimshaw, Ph.D., etc. Philadelphia: Claxton, Remsen & Haffelfinger. London: E. & F. N. Spon. 160 pp., 4to; 234 illustrations; cloth, $2.50 by mail postpaid.

Of this long announced book we can say that it more than meets our expectations. Simply as a piece of book-making, the clear type, heavy plate paper, profusion of illustrations (very many of them full page insets), and substantial binding, highly commend it. Saw literature has hitherto been very meager and not altogether impartial. "Worssam on Mechanical Sawing" (now obsolete), and some passages in the late John Richards' books, being the only sources of information on the subject, up to the almost simultaneous appearance on opposite sides of the Atlantic, of the Austrian, Prof. Exner's work in the German language, and the one here under review.

The style of the author is concise and correct; the numerous and widely-spread sources of information intelligently drawn upon, and duly acknowledged; the scientific classification of saw teeth and blades; the useful tables with which the book abounds, and the tracing of the gradual development of the saw from the first rudely nicked blade of the savage to the great "circular" with a rim-speed of two miles a minute, are worthy of much praise. From the pre-historic to the latest patent is a long reach, but the book spans it well. The almost numberless varieties of saws, little and big, hand and power, and for all sorts of materials, all seem to have received some attention at the author's hands, the copious index seeming to yield under inspection every saw topic that can be thought of.

The analysis of the action of different kinds of saw teeth in performing various duties with the materials usually sawed, is exhaustive without being wordy. The figures given are all on the authority of, or, as the author states, have been verified by, practical sawyers or saw manufacturers.

The book proper describes, under the leading classes of reciprocating and continuous acting saws, the various kinds of large and small hand, sash, mulay, jig, drag, circular, cylinder and band saws, as now and formerly used for cross-cutting, ripping, scroll-cutting, and all other sawing operations in wood, stone, metal, ice, ivory, etc., in this country and abroad; while the thirteen appendices constitute a book in themselves, going thoroughly into the details of saw manufacture, from the making of the steel to the final finish; the care and use of "circulars," saw filing (quite a treatise), spring setting and swaging, gumming and gulleting, band-saw brazing, gauges given in decimals, and vulgar fractions of an inch and fractions of an inch in millimeters; instructions for ordering saws; tables of log measurements, from 12 to 24 feet long (the logs, not the tables) and from 10 to 96 inches diameter; capacity of saw mills and power required to drive them, and an alphabetical list of United States patents from 1790 to 1880.

Specially valuable are the sections treating of the comparative economy in kerf by the various kinds of saws, double-cutting straight saws, inverted-toothed circulars, and the band saw.

The author's well-known reputation as a lucid and accurate writer on mechanical subjects, had led us to expect much from his promised book, and after a critical examination we are satisfied that both the author and publishers have done themselves credit in its production.

A companion work by the same author, that shall treat of "Wood-Working Machinery," is spoken of in the preface as being in contemplation. The author is at home in his chosen field, and that, like the present book, will doubtless prove to be an acquisition to mechanical literature.

Accidents and Emergencies. A Guide containing Directions for Treatment in Bleeding, Cuts, Stabs, Bruises, Sprains, Broken Bones, Burns and Scalds, etc., etc. By Alfred Smee, F.R.S. With Alterations, Corrections and Appendix by Dr. R. T. Trall. Illustrated with Engravings. New and Revised Edition. New York: S. R. Wells & Co.

This pamphlet is designed to furnish to the average intelligent reader a few simple and proper directions as to how to act intelligently and helpfully in cases of accidents or emergencies, which may unexpectedly occur in every one's experience. Most of the cases covered seem to be sensibly and correctly treated; others, however, very poorly. Take, for example, the directions given by the author for the resuscitation of the apparently drowned. He suggests placing the subject between warm blankets, and then to establish respiration by means of the very ineffective device of a tube applied to the mouth, the nostrils being closed. He does not even suggest the absolute necessity of first emptying the lungs and air passages of the water with which they are filled, without doing which—on the principle that two bodies cannot occupy the same place at the same time—it would puzzle most people to know how the poor unfortunate is to get any air into his water-logged bellows. The method of setting up respiration by means of a tube, we think is very ineffective. The forcible compression of the ribs and their sudden release, properly repeated, with the patient placed on his back with a roll of clothing under his back, so as to make the pit of the stomach the highest part of his body, is vastly more simple and efficient.

American Health Primers. "Long Life, and How to Reach It." By Joseph G. Richardson, M.D. Philadelphia: Presley Blakiston. 1879. Price 50 cents.
"Brain-Work and Over-Work." By H. C. Wood, M. D. Philadelphia: Presley Blakiston. 1880. Price 50 cents.

The above volumes, lately issued, belong to the admirable series of "American Health Primers," the general scope of which we have previously taken occasion to heartily approve. Both of these little books contain a surprising amount of information of interest and importance to all classes, and deserve, as does indeed the entire series, to have a place on every book shelf. The extent of ground covered by Dr. Richardson will appear from the following selection from his chapter headings, namely: Causes of Disease, and How to Avoid them; Heat and Cold as Causes of Disease; Contagion, and How to Escape it; Baths, and How to Take them; the House, and How to Build it; Impurities in Food, and How to Detect them; Exercise, and How to Take it; Sleep, and How to Secure it; Old Age, and How to Meet it.

Dr. Wood, in "Brain-Work and Over-Work," treats of the general causes of nervous troubles, the effects of work, rest in labor, the laws of recreation, rest in sleep, paroxysmal labor, stimulants during labor, signs of nervous break-down, etc.

Bulletin of the Torrey Botanical Club. New York, January, February, March and April, 1880.

To those who take an interest in the study of the trees of the forest and the flowers of the field—and there are many such among professional and business men—we would recommend the interesting publication noted above, now in its tenth volume. We are sure that those who merely study botany as a relaxation from the more serious business of life, will find much to edify and interest them in this publication; and as for the professional botanist, we do not see how he can well do without it. The January number is illustrated with two beautiful plates of a rare and curious fungus found on Long Island; and the February, March and April numbers are filled with a rich store of original botanical matter from various contributors, which is fully of as much interest to the general reader who is curious to learn the secrets of nature, as it is to the botanist.

This periodical is issued monthly, at the low price of $1 per year, and the editor is W. H. Leggett, Esq., of 54 East 81st street, New York.

Mathematical Drawing Instruments, and How to Use them. By F. Edward Hulme, M.A. New York: Bicknell & Comstock, 194 Broadway. 1880.

This book is the work of a teacher who has spent many years at the task of teaching beginners to become skilled workmen, and contains, therefore, the results of much practical experience. The book not only treats of the various instruments used in drawing, but gives instructions also regarding drawing and tracing papers, instructions for tracing and copying drawings, and in the use and mode of applying colors to represent different materials used in construction. It appears to be a complete and practical work, and will be found useful alike for the skilled draughtsman and the student of the art.

The enterprising publishers of this work, Messrs. Bicknell & Comstock, have just removed from 27 Warren street, where they have been for many years, to a commodious office at 194 Broadway. We trust that the success which has always attended this firm, will follow them in their new quarters, and wish them all the prosperity which they so well deserve for the many admirable works they have given to the world.

OTHER PUBLICATIONS RECEIVED.

Proceedings before the Assembly Committee on Railroads, on the Bill entitled An Act to Regulate the Transportation of Freight by Railroad Corporations. Remarks of Hon. Barton A. Hepburn in support of the bill. Albany, March 18th, 1880; Weed, Parsons & Co., printers.

How to Study Phrenology. With Hints on Comparative Observation and Practice; Directions for the Formation of Societies, with Constitution and By-Laws; References to the best Text-Books, etc.; also an Outline of the Principles of Phrenology, by H. S. Drayton, A.M., editor of the *Phrenological Journal*. With forty illustrations. New York: S. R. Wells & Co. 1880. Price 10 cents.

Fifteenth Annual Report of Rutger's Scientific School, etc., for the Year 1879. Trenton: State Print. 1879. From B. F. Pierce, Camden, N. J.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. V., No. 3. Washington: Government Print. 1879. From the Secretary of the Interior.

Abhandlungen über den Thomas-Gilchrist 'schen Process des Verbessemerens Phosphorhaltiger Roheisensorten, von Josef Gängle von Ehrenwerth. From the author.

Circulars of Information of the Bureau of Education. Nos. 1 to 5. 1879. Washington: Government Print. From the Commissioner.

We are indebted to the American Institute of Mining Engineers for the following papers: Silver Islet, by Thomas Macfarlane, Actonvale, Quebec, Canada; The New River Coal-Field of West Virginia, by S. Fisher Morris, M.E., Quinnimont, W. Va.; Note on the Defreest Journal-Bearing, by J. C. Platt, Jr., Waterford, N. Y.; A New Method of Dredging, Applicable to some Kinds of Mining operations, by R. W. Raymond, Ph.D., New York city; The Law of Fatigue and Refreshment of Metals, by T. Egleston, Ph.D., School of Mines, Columbia College, New York city; A New Air Compressor, by E. G. Spilsbury, Philadelphia; Atmospheric Oxidation or Weathering of Coal, by Dr. James P. Kimball, Lehigh University, Bethlehem, Pa.

Correspondence.

COMPARATIVE COST OF GAS AND ELECTRIC LIGHT.

To the Editor of the Manufacturer and Builder:

In the April number of your journal, I read an article entitled "Comparative Economy of Gas and Electric Lighting," a subject of such importance and universal interest that I am tempted to ask you for a little fuller information regarding the manner of arriving at some of the figures that appear in your treatment of it.

Taking, for example, your calculations on the cost of lighting the Riverside Mills with Edison's appliances. You estimate the cost of the necessary plant, including a 100 horse-power engine, with its machines and lamps, at $16,000. This, you say, means an expense of $1.66 per hour for lighting ("including 6 per cent interest on investment"). I cannot make it come that way, and would ask you to correct my figures. In the first place, like you, I take 6 per cent for simple interest. But how much of this plant is liable to the depreciation and final destruction that the engine is subject to? I should think, from my limited knowledge of such machinery, at least $12,000 worth of it—and how long will this proportion of it last? In other words, what is the life of this class of machinery? If we assume 50 years, that would necessitate charging 2 per cent per annum for a sinking fund to cover the loss of $12,000 of the investment in 50 years. Then, taking the salary of a competent engineer at $800, I have:

6 per cent on $16,000=$960, simple interest.
2 per cent on 12,000= 240, sinking fund.
Engineer's wages..... 800

Interest and attendance, $2,000 per annum.

Again, before the estimate can be reached, it must be known for how many hours a day this engine, with its 1,000 lights, would be started up and run. For all the year round, long days and short days, I think it would be fair to Mr. Edison to say 3 hours a day for 300 working days. This gives 900 hours a year as the active, useful time of the engine and the rest of the investment. According to my calculations, therefore, the Riverside Mills would be paying $2,000, in interest and attendance alone, for 900 hours of the electric light, or $2.22 an hour. This, deducted from your estimate of $1.66 total expense, leaves a balance on the wrong side for fuel, repairs, oil, insurance, etc. Yours respectfully, Foreman.

New York, April 15th, 1880.

Answer.—In replying to "Foreman's," very practical letter, which we have read with much pleasure, we beg at the outset to disclaim all editorial responsibility for the statements and calculations made in the article on "Comparative Economy of Gas and Electric Lighting" which he criticises. They are presented specifically on the authority of one of our contemporaries, the name of which is given at the heading of the article, and while offering this, as we do many other matters of general interest, as current scientific gossip, we were, as we always try to be, careful to place the article to the credit of the journal from which the abstract was made.

With this explanation, we will proceed to notice some of the points made in "Foreman's" letter, in the light of the article. The statements as to details and cost of Mr. Edison's plant in the case named, were evidently made by our neighbor upon Mr. Edison's authority, and unless "Foreman" has means of information much more satisfactory than we have, he will find himself very much puzzled to bring order out of the widely differing statements as to the economy of lighting by the Edison system.

In the article in question, the statement is made, on Mr. Edison's authority, that he "gets 10 lamps, or 150 candles of light, per hour per horse-power of engine." In a late discussion of the subject before the Franklin Institute, Prof. Elihu Thomson was of opinion that a liberal estimate would be "80 candles per horse-power;" Prof. R. E. Rogers' estimate was about 40 candles per horse-power; Prof. Marks' estimate is about 68 candles; Profs. Barker and Rowland, as the result of a number of tests of the efficiency of the Edison light, find it to vary between 109 and 209 candles per horse-power of electricity, which would be equivalent to about 65 to 125 candles per horse-power of engine, at 60 per cent of economy in generator, or 76 to 146 at 70 per cent economy (which they claim). Profs. Morton and Mayer find it to be about 72 candles per horse-power. From this great diversity of statement, it will be manifest that the question of economy in the operation of the Edison system is very far from being settled.

In the estimate of $1.66 per hour as the cost of running 1,000 lamps, delivering 15,000 candle lights per hour, the data, so far as we can *guess* at them, were probably as follows:

$960, annual interest on $16,000
100, annual cost of repairs, etc.
600, fuel.

$1,660, for say 1,000 hours, or $1.66 per hour as above. In this estimate, which, as above stated, we give purely as a guess, it is stated in the article that no allowance is made for royalty for owners of patents; and it certainly cannot include the wages of an engineer for attendance, and certain incidental expenses. It has probably been assumed that the additional power and attention required when the lights are on, could be looked after and supplied by those already employed about the mill, without demanding a specially chosen attendant. Where the operation is conducted on so large a scale, however, it is at the least very questionable whether special service could be dispensed with, and the expense of this service would necessarily go to swell the cost of the light.

Taking even the best estimate of the economy of Mr. Edison's lighting system—say 150 candle lights per horse-power—and without any desire to throw cold water on a project which has so many warm friends and advocates, we believe that a vast amount of difficulty must yet be overcome before the electric light will be able to compete with coal gas for domestic purposes. One great advantage of gas light lies in the simplicity of the arrangements for its distribution, and their nonliability to derangement and waste; while the machinery of any electric lighting system that aims to indefinitely subdivide the electric current for domestic uses, must necessarily be so highly refined and delicate, as to make it an open question if it can ever be made to stand the test of actual service. At Mr. Edison's laboratory things may work smoothly enough, but Tom, Dick and Harry are not going to draw on their kid gloves every time they want a light.

The following comparison of relative economy of gas and electric light, which we shall base on the figures of several professional gentlemen who have examined and expressed an opinion of the Edison system, will, we think, be far nearer the truth than those which "Foreman" calls into question. In this estimate we convert the candle lights into their equivalent gas jets of 16 candles (which is the usual duty assumed for a 5-foot burner), and take the average cost of one horse-power per hour, based on the practice of first-class shops, to be 4 cents, which includes fuel, attendance, wear and tear, and lubrication:

Authority.	*Light in Gas Jets per Horse-Power per Hour of Engine.*	*Comparative Cost of Illuminating Gas per M. Feet.*
Edison	9.4	$0 85
Rowland and Barker	9.2	0.87
do. do.	5.25	1.52
Thomson	5	1.60
Morton and Mayer	4.5	1.78
Marks	4.3	1.86

Taking the best of these figures, we are safe in saying that if coal gas can be put in the holder at a cost of 85 cents, or less, the convenience and simplicity of its distribution will still continue to give it the preference over the electric light with its complex and very delicate appurtenances, even supposing the cost of the plant in the case of the electric system would not exceed that of the other, which is assuming very much. But those who are posted, know full well that illuminating gas can be made and sold at a profit for even less than 85 cents per 1,000 feet, and should competition between gas and electricity ever arise, this fact will be amply demonstrated to the satisfaction of the payers of gas bills.

From the previous statements made, the calculation of cost would be for 1,000 hours of service for 100 horse-power engine, on above assumption of 4 cts. per hour per horse-power $4.00
6 per cent interest on $16,000 per hour..... 11

Cost per hour..... $4.11

This result, we think, will be a much closer approximation to the truth than $1.66.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2616) Mechanical Lamp.—I am a constant reader of your journal, and have derived much useful information from it. I would like to get some advice about an idea I have had for some time of constructing a lamp for burning petroleum without the use of a chimney, by using a coiled spring movement to give an air current. I think such a lamp would have many points of advantage. I have, however, no one to advise me here, and do not want to go to any expense in fees to patent solicitors and model-makers unless I am tolerably well assured that my idea would be a patentable one. Can you aid me in the matter?—W. B. E., Mechanicsburg, Pa.

(2617) Silicate of Soda in Soaps.—Is silicate of soda, which I am told is a common ingredient of many soaps, an injurious adulterant? By answering through your journal you will oblige a subscriber.—B. W. P., Big Bend, Ind.

(2618) Factor of Safety in Steam Boilers.—Your explanation in your last month's issue of my query on elastic limit, was very acceptable. Will you let me trouble you again by asking what is meant by the factor of safety in steam boilers, and how it is fixed?—E. H. H., Wilmington, Del.

(2619) To Learn Assaying.—I have a strong notion to learn assaying, as I think I could turn the knowledge to good account in the mining regions of the West, where I want to go. I am not able to get any advice here as to the time required to acquire a sufficient knowledge of the art to practice it, the cost of instruction, and of the outfit I would require. I take it for granted I must go to Boston, or some other large city, for the purpose. I should explain that I am a young man of nineteen, with a fair education, and have studied elementary chemistry, having always had a strong liking for it. Can you give me some advice?—H. M. J., Lynn, Mass.

(2620) Touch-Stone.—What is a touch-stone? Is it not, as I suppose, a name handed down to us from the ancients to indicate some purely fanciful idea, like the occult properties or virtues supposed to exist in precious stones?—P. S., Atlanta, Ga.

(2621) Diamond-Cutting.—Is it known by whom the art of diamond-cutting was first invented?—P. S., Atlanta, Ga.

(2622) Colored Photographs.—Can you tell me if photographs of objects in their natural colors have ever been made?—T. S. D., Salem, Del.

(2623) Utilization of Blast Furnace Slag.—I would like to know, Mr. Editor, if any serious attempts have ever been made to utilize the slag of iron furnaces. A reply through the columns of your journal would greatly oblige one of your readers.—J. H. S., Kimberton, Pa.

(2624) Crystallizing Carbon.—If I compress carbonic acid gas, then by using potassa, could I crystallize the carbon? As potassa has such affinity for oxygen, would it not set the carbon free? or would it not be more reasonable to use spongy platinum to absorb the oxygen? Please answer through your valuable journal. Your answers I greatly appreciate, because you seem to aim to give the information asked, not, like a certain journal of excellent standing, which I must say gives a great many answers that are far from correct.—J. B., Georgetown, D. C.

(2625) Unknown Mechanical Term.—In reply to your postal card asking for further information in regard to the word "Jijucs," I send you the sentence in which it occurs in "Boston Machinist," by Walter Fitzgerald, published in 1870 by John Wiley & Son, New York. It says, under the head of "Tempering": "Jijucs and gauges, also common lathe tools, need no drawing, being tempered enough when merely hardened." As the work appears to be very carefully printed, it does not seem as though it were a typographical error.—C. L. N., Worcester, Mass.

(2626) Is Oleomargarine Wholesome?—Do you consider artificial butter, called "oleomargarine," wholesome as an article of food?—J. S., Haddonfield, N. J.

(2627) Painting a Tin Roof.—I wish to roof an old building with tin. The roofer tells me that it is an unnecessary waste of time to paint the under side of the sheets. Is he correct?—E. P. T., Youngstown, Ohio.

(2628) Number of Periodicals in the World.—Have you a record of the number of periodicals published in the world?—A. B. T., Washington, D. C.

REPLIES.

(2616) Mechanical Lamp.—We would state in reply to W. B. E. that we cannot presume to say whether his idea is *patentable* or not, as that is a question entirely outside of our province as editor of a technological journal, and one that only one skilled in the practice of the profession of patent solicitor would be competent to answer. While we must refrain, however, from giving an editorial opinion on the question of patentability for the reason named, we have no objection to give our correspondent our opinion as to the *originality* of his idea, which we proceed to do in what follows. Mechanical "blast" lamps, designed specially to do what W. B. E. has in view, have been in use for some years, and he will have no difficulty in satisfying himself on that point if he will take the pains to order one from a lamp dealer in his town, who will doubtless be able to obtain one for him. From the few additional facts that we will add for his information, our correspondent will find that the field of mechanical lamps has been very thoroughly "done." The earliest lamp using a mechanical movement, so far as we know, was the so-called "Carcel" lamp, a French invention at least 20 or 30 years old, and very widely known, though at present but little used. This lamp is designed to burn fat animal oils. The mechanical movement, however, is used in this case to pump up the oil from a reservoir in the lamp to the wick, and the air supply to the flame is obtained by means of a chimney, as usual. In a lamp known as the "Jones and Hitchcock" lamp, an American invention of perhaps ten years ago, and which is also widely known and used, the very idea of W. B. E. is practically utilized. This lamp is specially designed "to burn kerosene without a chimney," and to effect this object it is supplied with a mechanical movement which operates a blower, which furnishes the flame with its necessary air supply. This is practically what our correspondent is after. But the matter of mechanical lamps has not rested here, for in what is known as the Hitchcock lamp, a recent invention, which is designed specially to burn fat and greasy oils without a chimney, the peculiarities of the Jones and Hitchcock and Carcel lamps are combined, in that the mechanism performs the double duty of furnishing the air supply to the flame and at the same time to deliver the oil to the wick.

In the invention of mechanical lamps, therefore, so far as embodying the idea our correspondent names, nothing remains to be done, as the ground has already been covered. It is possible that he may have some very much improved mechanism in mind that would make the existing lamps of this type more serviceable; but we would suggest to him the advisability of making himself thoroughly acquainted with these lamps before going ahead on his own account.

(2617) Silicate of Soda in Soaps.—This question has been propounded to us several times during the past few years, and is one of some interest. In answer, we would say that though the general popular impression is that the use of silicate of soda in soaps is an injurious adulterant in the sense that it lessens their cleansing properties, we do not agree with that opinion. The best reply, stating the reasons for this assertion, we find in the answer to this question by the Committee of Judges on Drugs, Dyestuffs and Chemicals at the Franklin Institute Exhibition, held at Philadelphia in 1874. This committee included in its membership several eminent chemists, whose opinions are entitled to great weight. They say that soap is a combination of a fatty acid with alkali. Its cleansing property lies in its capability of assimilating a certain quantity of fatty matter, and in the formation of a lather which offers a large surface for the removal of dirt. The silicate of soda having a composition similar to that of soap, has the very same properties. It can assimilate fatty matters, and possesses an advantage over ordinary soap in that the silicic acid particles which separate from the combination, offer a material for gentle friction between the fibers of textile fabrics and the like, which, without being injurious to the fiber, removes dirt more effectually than soap alone would. The committee assumed the responsibility of stating that they "took the opportunity of correcting the prevalent erroneous opinions upon this subject, and recommend the silicated soaps and washing silicates as a decided improvement both in work done and saving effected." With this opinion we see no reason to disagree.

(2618) Factor of Safety in Steam Boilers.—Like the former question of E. H. H., this one will require some preliminary explanations, which we will endeavor to give with all the more pleasure since he has been polite enough to acknowledge his satisfaction with our last reply. The strength of a steam boiler depends on a variety of things, namely, the material of which it is made; the form and dimensions of its interior and exterior parts; the strength of intersecting joints, such as steam domes, etc.; the strength of the riveted joints, and that of the system of stays which bind the parts of the whole structure together. In calculating the ultimate strength of a boiler, therefore, all the factors above named must be considered, and from the result obtained, the safe working pressure is estimated from a simple and arbitrary rule, which will be referred to further on. The ultimate strength of a boiler is the greatest pressure which it is capable of withstanding without danger of rupture. It is not necessary that the failure shall occur at the instant of over-pressure, but whether it is likely to occur at all by a continued application. Now, knowing from the results of many and carefully conducted experimental trials, the longitudinal and transverse strength of iron and steel plates, the strength of riveted joints, and knowing, at least to a great extent, the nature of the destructive influences which are constantly at work, and constantly lessening the strength of the boiler, *a certain fraction of the ultimate strength*, called a "factor of safety," is selected as a basis of calculation at which boilers are considered safe, after taking into account all the contingencies incident to boiler-making, and to its ordinary usage in regular service. If a boiler is capable, for example, of withstanding an ultimate pressure of 900 pounds per square inch, and is used in service at a pressure of 150 pounds, there is said to be a factor of safety of 6 (950÷150), which indicates the relation between the safe working pressure and the ultimate strength. Just what this figure should be, it appears, has never been universally agreed upon, but it has been narrowed down to between 6 and 8. In this country, 6 is the ordinary factor of safety employed in all kinds of boiler-work; and in England it varies between 6 and 8. It may be added, that it is the practice of most boiler-makers in this country, to make no boilers less than one-quarter inch thick, no matter if the "factor of safety" should rise to 10, or even 20. By consulting "Barr on Steam Boilers," from which we have largely drawn for the foregoing facts, our correspondent will find nearly everything of interest and value in relation to the steam boiler—its materials, appliances and practice—very fully and comprehensibly set forth.

(2619) To Learn Assaying.—We have a keen recollection of a remark made lately to us by a prospecter who had come East to dispose of a claim, and of whom we asked whether there was not an excellent field for skilled assayers in the active mining districts of the West. The answer was, "Assayers? Why, the woods out there are full of them!" There is doubtless a good deal of truth in this answer, and our correspondent will find, no doubt, that the active districts are pretty well supplied with assayers. But if he seriously contemplates going out there, he will find that a practical knowledge of this art will be very useful to him. New mining districts are being opened every season, and though "the woods are full of them," he may find a chance for a good opening to practice; and in any case, a knowledge of the art of assaying in a country that is flowing over with opportunities to make lucky strikes, cannot help but be very serviceable. As to the time required to acquire the art, we think a young man of fair education and intelligence—and our correspondent's letter shows him to be considerably above the average—should have no difficulty, by industry and application, in learning enough for practical purposes in, say, three months. In most of the large cities, like New York, Philadelphia, and Boston, there are analytical chemists who make the work of instructing students in analytical chemistry and assaying part of their business, and H. M. J. will have no trouble in finding the address of several such parties in Boston. On the question of cost, we think the charge for such instruction would be somewhere about $75 to $100, and that of the outfit required, about $150 to $200 more.

(2620) Touch-Stone.—The touch-stone has, indeed, been in use long enough to almost come to be considered as handed down to us from the ancients. Its use certainly dates back several centuries. It is by no means the fanciful affair that our correspondent imagines it to be. On the contrary, the property of the touch-stone is a highly practical one, and it will be found in possession of almost every jeweller and assayer in the world. It is a black silicious stone, which is used, on account of its dark color, dense texture, and great hardness and indifference to chemical reagents, to test approximately the quality of various alloys of gold and silver (or copper). A set of "touch-needles," composed of a series of needles, each made of an alloy of known fineness, is used to get at the quality of a piece to be tested. A mark of the touch-needle and of the piece to be tested are made on the stone, and their luster and resistance to solution by acids is noticed. By repeating this operation with different touch-needles, until markings are obtained that behave alike, the carat value of the tested sample can be determined with sufficient accuracy for all the practical purposes of the jeweler.

(2621) Diamond-Cutting.—The same inquirer asks if it is known by whom the art of diamond-cutting was invented. We answer, No. It has been very generally attributed to Louis de Berquem, a resident of Bruges, in the year 1465; but there seems now to be strong evidence that the art had been practiced both in Europe before Berquem's time, and for a much longer antecedent period in China and India. Dieulafait, for example, says on this point, that the inventory of the jewels of Louis of Anjou, drawn up between 1360–1368, included a number of cut diamonds; and that 150 years at least before Berquem's time the art had been practiced in Paris. One Parisian diamond-cutter, named Herman, indeed, according to this author, had made notable progress in this art at the beginning of the fifteenth century. The discoveries of Berquem, Dieulafait thinks, consisted in the construction of a polishing wheel, to be used with diamond dust, and a systematic arrangement of the facets. The grand center of the diamond-cutting industry during the fifteenth century, was Bruges, and from there pupils of Berquem passed to Antwerp, Amsterdam and Paris, where they established other work-shops for diamond-cutting. Those at Paris did not at first succeed, but under the subsequent patronage of the Cardinal Minister Mazarin, the art took an important position. On the death of its patron, however, it declined, and the revocation of the Edict of Nantes gave it a blow from which it never recovered. At the present day, Amsterdam is the headquarters of the industry, and the establishment of M. Coster is the largest in the world. It is also, to some extent, carried on at Paris, London, Boston and New York.

(2622) Colored Photographs.—Experiments in this direction have been numerous, but thus far experimenters have met with but indifferent success. A recent French method, which seems to us to be a decided step in the right direction, is thus described: The operator takes three photographic impressions of any desired object, by sifting the light through solutions which will respectively exclude the green rays, the yellow rays, and the violet rays. The impression from which the green has been excluded, if developed under green light, will appear intensely green at points where the original was the greenest, and pale green or black at the points where the green of the original was mingled with other colors, or was entirely absent. By combining the three negatives and superposing the images by the help of reflecting prisms, an approximate solution of the problem of the fixation of colors by photography is obtained. This procedure, though a promising one, however leaves very much to be desired on the score of directness.

(2623) Utilization of Blast Furnace Slag.—J. H. S. must be only a "semi-occasional" reader of the Manufacturer and Builder, or he would surely have met with a number of articles bearing directly upon the subject of his inquiry, within the past year or two. For his information, however, we will endeavor to collate in brief the facts on this subject, which we have noticed at greater or less detail during that time. Blast furnace slag is largely utilized, like other stone, for ballasting the road-beds of railways and macadamizing highways, in this country and elsewhere. It is largely used in England and Germany for building-sand and building-blocks or bricks, and for paving and like uses. It is also manufactured and used in large quantity in the form of mineral wool (called "silicate cotton" in England, and *Schlacken-wolle* in Germany), made by acting on the slag, as it runs from the furnace, by a jet of steam, which blows it out into the finest threads, so that the product resembles cotton-wool in appearance and texture. This is used for covering steam pipes and boilers, and for many other purposes as a non-conductor of heat. Blast furnace slag has also been of late successfully manufactured into the cheaper grades of glass, an industry which we are told is now a thriving one in some of the iron-working districts of England. It has also of late been proposed for the manufacture of hydraulic cement by making the proper admixture of lime with it in a finely ground condition. Most of the industrial applications of slag have only recently sprung into existence, and may be reasonably expected to largely increase in dimensions in the future. We have only indicated in this reply the several applications that have been proposed for this material. For the details of these several processes of manufacture, we must refer our correspondent to the back numbers of this journal, in which he will find many references to the subject.

(2624) Crystallizing Carbon.—The decomposition of carbonic acid by means of the alkaline metals, sodium and potassium, and the separation of its carbon in solid form, can easily be accomplished, and forms one of the most remarkable and instructive lecture-room experiments in the whole range of experimental chemistry. As commonly performed, a slow current of carbonic acid gas is passed through a glass tube in which a fragment of metallic potassium has been placed. The metal is strongly heated by the application of a gas lamp, and when the temperature has reached the proper point, a reaction takes place and solid carbon is deposited. The potassium at this temperature is enabled to deprive the carbonic acid of its oxygen, combines with it to form potassa, and the separated carbon is deposited in solid form; but, unfortunately, not in crystalline form of the diamond, but as a black amorphous mass. It is probable that the crystallization of the carbon in this case is prevented by the suddenness of the reaction, seeing that the decomposition takes place with energy so soon as the requisite temperature has been reached; and it is not at all improbable, if this reaction could be made to take place very gradually, that a crystallization of the carbon would be effected. The idea suggested by our correspondent, of bringing carbonic acid gas under great pressure in contact with potassium (not with potassa, as he has it), might bring about a slow decomposition, and the separated carbon might be crystallized in the form of the diamond, but it would be impossible to predict the result with certainty, since we know so little of the actual conditions under which the diamond is formed. The only way for our correspondent to satisfy himself on this point, is to try the experiment. His suggestion as to the employment of "spongy platinum to absorb the oxygen," would not work. Spongy platinum has the property of greedily absorbing gases, but cannot decompose a gaseous compound like carbonic acid. A somewhat analogous procedure to that of our correspondent, we remember to have read some time ago, by which it was affirmed minute crystals of diamond were produced. This process consisted in simply bringing pieces of phosphorus in contact with liquid bisulphide of carbon, and the result was asserted to be, that after several months, minute diamond crystals were formed, the phosphorus slowly uniting with the sulphur and liberating the carbon. This statement, however, lacks verification. We anticipate that sooner or later diamonds of considerable size will be produced in the laboratory, but we are as yet only on the threshold of discovery in this field of investigation, and there are many directions of chemical research that promise more profitable results than this one.

(2625) Unknown Mechanical Term.—We regret that we are quite unable to help our correspondent out of his difficulty. The word is utterly unknown to us, and to such of our engineering friends as we have asked about it. If any of our mechanical readers are better posted, we would be pleased to hear from them.

(2626) Is Oleomargarine Wholesome?—Yes. We know of nothing to call the wholesomeness of artificial butter, better known by the name of "oleomargarine," into question. In the process of its manufacture, the fresh fat of animals is rendered in such a manner as to secure it quite pure, odorless and tasteless, in which condition it is churned with milk, etc., by which process it is converted to the consistency of and appearance of ordinary butter. The conditions required for the successful conduct of this manufacture, demand that the raw materials employed shall be pure, and cleanliness in the process is equally essential; and when these facts are taken into consideration, in connection with the circumstance that the chemical composition of the product is essentially the same as that of butter made from cream, we see no reason why oleomargarine should not be considered as wholesome an article of diet as natural butter. This opinion, we believe, will be found to be that of most chemists of eminence who have given the subject their attention.

(2627) Painting a Tin Roof.—We should say the roofer who made such an assertion, gave you bad advice. So long as the roof is perfectly tight, so that no moisture can find its way underneath, it does not matter whether the under side of the sheets are painted or left bright. But give the rain the least chance to find its way under a crevice at the sides or the seams, and the moisture will spread, and the roof will commence to rust through from beneath very quickly. Every house owner knows the difficulty of keeping a tin roof perfectly tight, and has experienced more or less trouble from leaks of this kind. And for the same reasons that the outside of a roof should be protected by paint, the under side also should be protected, unless our correspondent wants to give the roofer a job every year or so. The cost of a coat on the under side of the sheets is trifling, compared to its probable service in prolonging the integrity of the roof. Have it done by all means.

(2628) Number of Periodicals in the World.—The total number is about 23,000 of which Germany boasts 3,778; England, 2,509; France, 2,000; Italy, 1,226; Austria, 1,200; Russia, 500; Asia, 387; Africa, 50; America, 9,129; and Australia, 100.

THE MANUFACTURER AND BUILDER.

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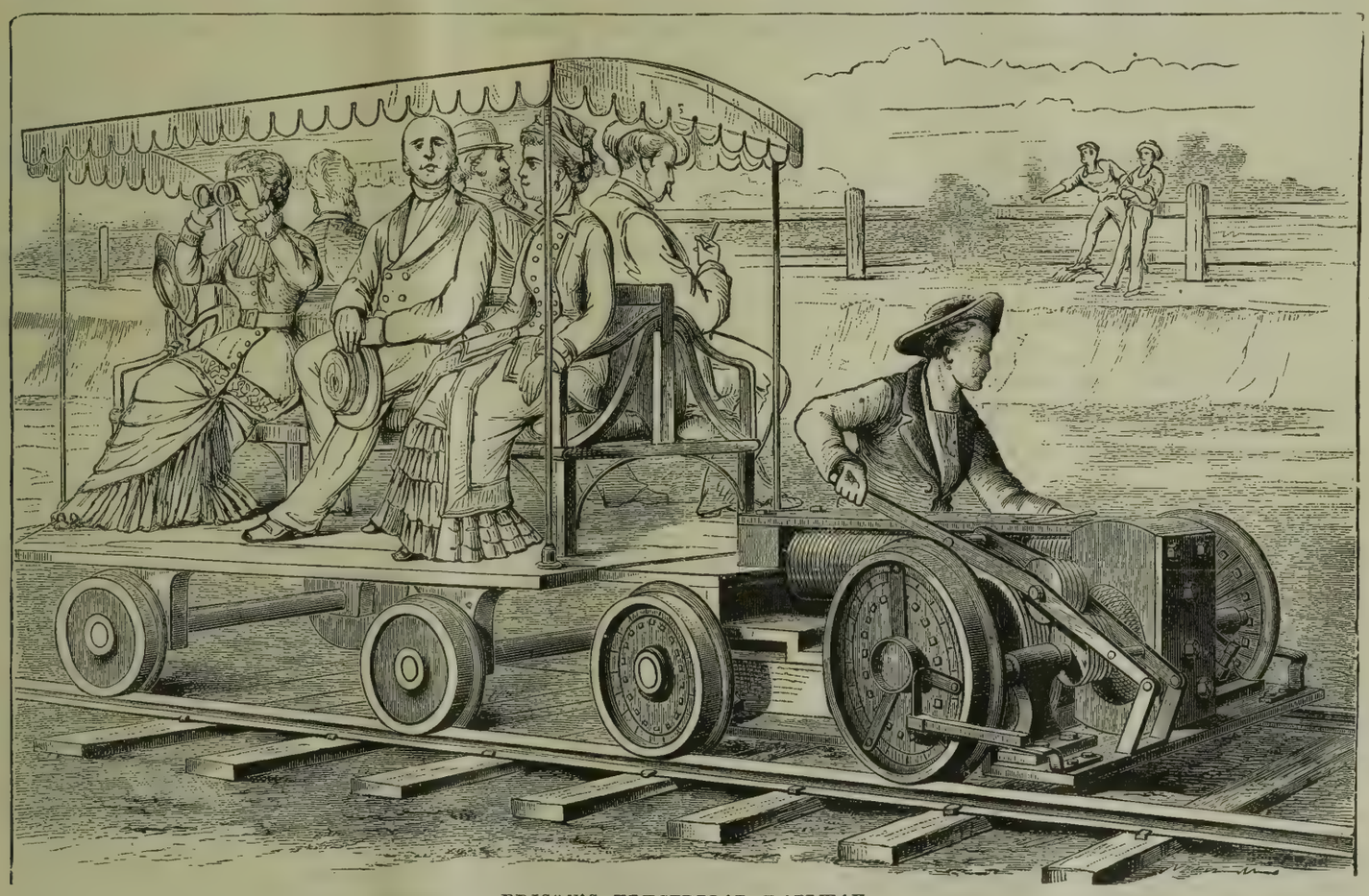
Electrical Railways.

The suggestion that electricity might be made to serve as a motive power for railways is not entirely a new one. The idea has been entertained for years, but until lately has remained an idea, or at best has found expression only in some scientific toy, which, like a baby, might or might not amount to something in time. The development and recent rapid perfection of dynamo-electric machines, however, which have given us what before was lacking—that is, a comparatively cheap means of generating and maintaining powerful electrical currents by the direct conversion of mechanical force into electricity, has supplied the long-sought-for means of applying this agent to an infinite variety of practical uses, for which its cost had hitherto been an insuperable obstacle. For, as most of our readers will be aware, these machines have practically solved the problem of the cheap production of electricity, enabling us to convert mechanical energy—no matter how generated, whether from steam engine, wind, or waterfall—directly into electricity, and have opened up a wide field of speculation as to the possible extensive introduction of electric engines to do the work of steam, over which it possesses a number of advantages, the most obvious of which resides in the fact that it may be transmitted with very little loss over great distances by metallic conductors, and made to drive electrical engines located at distant points, or to furnish light for towns, cities, etc. The practicability of the use of electricity was tersely presented before the British Iron and Steel Institute in the following terms: The president of that association declared that, so long as the source of electrical power depended upon the galvanic (chemical) battery, it must, in the present state of things, remain far more expensive than steam power, for the obvious reason that zinc, which is the fuel of the galvanic battery, is vastly more expensive than coal—the fuel of the steam boiler. If, however, a natural force, such as water-power, could be utilized to generate electricity economically, the case would be very different. A dynamo-electric machine actuated by water-power, could be made to generate powerful electrical currents, which could be transmitted through insulated metallic conductors to a great distance with but little loss, comparatively speaking, and could thus be made to run magneto-electric engines to do the work of steam in our factories and work-shops, to ignite electric lamps, etc.

We have cited the foregoing simply in verification of our statement of the possible future substitution of electricity for steam power on an extensive scale. It will be apparent also to our mechanical readers that there may be numerous cases where it will be advantageous on the score of convenience, if not of economy, to employ steam-driven dynamo-electrical machines, not only for the production of light, for which use they have already been very largely introduced, but also for the production of mechanical effect. It is on this principle that the latest novelty in the application of electricity—the electrical railway—is based.

The credit of having first practically demonstrated the possibility of success in this direction must be accorded to Dr. Siemens, who constructed and operated an electrical railway on a practical scale at the Industrial Exhibition held in Berlin in 1879. The principles of its operation are stated generally in what has preceded—that is, the conversion of motive force into electricity, and the conversion of the electric current back again into motive force. The details will be sufficiently clear from the following explanations: If we have two dynamo-electric machines, designated as A and B, which we connect by metallic conductors, they form a complete system for the transmission of power. Motion imparted to the machine A will generate an electrical current, which the machine B will convert back again into motive power. In the electric railway of Dr. Siemens, the machine A is driven by a stationary engine located at one end of the road; the rails are used as conductor, the current generated by the machine A being taken from an insulated center



EDISON'S ELECTRICAL RAILWAY.

rail by a metallic brush, actuates machine B, its motion being communicated by suitable gearing to wheels on which it is mounted, and the current is returned to the electric generator by the ordinary uninsulated rails.

Mr. Edison, it appears, has been turning his attention to this same interesting problem, and has lately constructed an electrical railway at Menlo Park, with which some practical experiments have been made with very promising results. The railway in question is a circle about half a mile long. The motor is substantially one of Mr. Edison's electrical generators, the motive power being supplied by a stationary engine, and this power converted into electricity by a similar generator. The general principles of this arrangement are, therefore, identical with those employed by Siemens. The details, so far as they have been given, however, appear to be somewhat different. In Mr. Edison's arrangement, the electrical current from the stationary generator is conveyed to the track by two copper wires, one wire being connected with each rail.

The invention is in process of being perfected, and at the proper time full details of the motor and of its operation are promised. The design of the experiment is said to be to test the applicability of this system for the use of mining districts, large farms, plantations, etc. What its future development may be no one can affirm. Dr. Siemens has already progressed so far with his system as to have applied to the municipal authorities of Berlin for permission to erect an elevated electric railway across that city, so that no question exists on the score of practicability. It is not at all unlikely that in the not very remote future we may have electrical tramways and elevated railways in common use in our cities.

Mr. Edison's motor, on a recent trial trip, developed a speed estimated at about 25 to 30 miles per hour, and he claims to realize 70 per cent of the power applied to the generator. The engraving on the preceding page shows the general appearance of this novel railway and its equipments.

Extinguishing Fires with Steam.

The technical journals are again mooting the subject of the extinguishment of fires by means of steam, which appears to attract periodical attention. There can be no question that under certain circumstances, the application of steam for the purpose named will be vastly more useful and effective than that of any other agent. These circumstances may be briefly described to be, where a building, or portion of a building, is on fire, and where the fire has not burned out to the air. Under these circumstances steam may render invaluable service, since, in most cases of this character, the fire can be speedily extinguished by its use with but a fraction of the loss to merchandise (or other valuable contents) that invariably attends the use of water.

Respecting the efficiency of steam in extinguishing fires in confined spaces there is some very extraordinary evidence, which, however, would take up too much of our space to detail. Enough, however, has been shown respecting its utility to amply demonstrate that every factory building, workshop, etc., where steam is used, should be supplied with a steam fire extinguishing plant, which need only consist of a system of pipes leading into the several rooms or stories, by means of which, in the event of the breaking out of a fire at any time or in any portion of the establishment, steam could be almost immediately thrown in volumes into the threatened quarter. Such an arrangement as that here suggested, costs but little to fit up; costs nothing to maintain when not in use, does not take up valuable space, and should fire accidentally break out, its presence and almost instant availability—so soon as the room is cleared of its occupants and the doors closed—will often prove to be invaluable in checking the spread of a calamitous fire.

The value of such an arrangement as that here proposed is very little understood or appreciated by proprietors of large factories, mills, etc. We happen to know of two large establishments, however, where such a system is provided, namely, the kerosene works of the Downer Company at South Boston, and the workshops of Morris, Tasker & Company of Philadelphia; in the first named, the effectiveness of this safeguard has repeatedly demonstrated itself; in the second, the opportunity of testing its utility has happily not yet been afforded.

The arrangement is extremely simple. A series of independent steam pipes lead from the boiler-room to the several departments of the works, while one of the most open and easily accessible positions on the ground floor is chosen as the place where the steam service may be controlled. At this place (in the case of Morris, Tasker's & Co's. works), the pipes leading to the different quarters of the works, are painted, each of a different color, and for additional security against mistakes in the excitement of the moment, the name of the department to which it leads is printed in distinct letters on each of them, and the threatened apartment can be instantly deluged with steam by the simple turning of the appropriate valve, so soon as warning of the danger is given.

A similar plan could be readily adapted to large buildings like churches, public halls, theaters, etc., wherever steam is used for heating purposes, and would doubtless amply prove its efficiency should occasion call for its use.

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A Nuisance that should be Abated.

One of our contemporaries, in referring lately to the immense increase in telegraphic communication, and the rapid improvement of telegraphic methods, and alluding to the visible evidences of these facts, in the net-work of wires stretching from building to building and from chimney to gable, that everywhere meet the eye in our cities and towns, designates the age we live in, as the "wire-age." The term is not inappropriate, but it would be, we submit, in better keeping with the eternal fitness of things, if the wonderful progress in telegraphy that we refer to above, had been accompanied with similar progress in telegraphic service. America has played a distinguished part in the development of the telegraph, but in spite of this fact we are far behind most European countries in many of the details of the science; and in no particular do we stand so far behind as in the construction of lines. We refer here to the aerial or post system of stringing wires overhead, and especially to the continuance of this practice in the streets of our cities and towns.

The impression seems to prevail that underground systems of line construction are more or less uncertain, and they have thus far not advanced beyond the experimental stage, and this impression seems to be entertained by the writer of the "wire age" article, which closes with the following sentence:

"The time is not far distant when additional wires will become necessary for the purpose of electric lighting, and, perhaps, warming. In the years to come the whole country will be covered with them unless some plan is devised by which electrical currents can be conveyed in the earth by wires protected in tubes of clay or metal. It is certain that some method of this nature must be adopted, and that quite speedily."

But so far is this from being true, that on the contrary the underground system has been practiced successfully in European countries, for at least 25 years, and at the present time, there is scarcely a city or town of any note—certainly not on the continent—where the underground system, in one or the other of its numerous modifications, is not in use, and in many of them not a single pole or overhead wire is to be seen. In proof of this assertion, we need only refer to the report of Mr. David Brooks, U. S. Commissioner to the Vienna Exhibition in 1873. He says, in reference to the subject: "The wires are run underground in the cities of Berlin, Breslau, Dresden, Stettin, Hamburg, Bremen, Cologne, Frankfort-on-the-Main, Mayence, Carlsruhe and other large cities and towns in Germany; and in Geneva, Lausanne, Berne, Neufchâtel, Zürich, Winterthur, Schaffhausen, St. Gall and Lugano in Swit-

zerland, and in nearly all the cities of Europe, neither poles nor wires are visible, but the system of underground cables is used instead." These observations, be it remembered, were made 7 years ago, and since they were written, the underground system has received an immense impulse. So well satisfied were the German electricians of its practicability that they elaborated a plan for extending it beyond the cities and towns and substituting underground lines for the overhead lines throughout the entire empire, and at the present time a complete network of underground cables connects all the chief cities, towns and fortresses of Germany, the total length of which will certainly aggregate thousands of miles. Germany has taken the initiative in the matter of adopting the underground system universally, but in many other localities in Europe outside of the cities and towns (where, as above noted, the subterranean lines are altogether used), there are extensive underground cable lines, and the tendency of the best telegraphic practice is towards the total abandonment of the aerial system. What the advantages of the underground system are, as contrasted with the pole system, will appear from the following brief summary: The underground system obviates to a great extent the numerous causes of interruption of communication resulting from the breaking of wires by accident or malice, or accumulations of sleet, ice, etc., the frequent falling of poles and the general imperfection of insulation so severely felt by operators during a long spell of wet weather. We will say nothing of the disfigurement of the highways by poles and wires which no amount of ingenuity can make sightly or attractive, and whose natural hideousness is rendered more hideous by their common adornment with shipwrecked kites and old hoopskirts.

We have no need to wait for some plan to be devised, as our contemporary intimates, before abandoning the unsightly pole system in our cities and towns. The plans are already matured elsewhere. They are in successful operation and have been for years, and but for the monopoly of the telegraph in this country we should have witnessed the disappearance of the abomination of poles and overhead wires long ago. Let our municipal authorities insist on their banishment from our streets—and they will go.

High Railroad Speeds.

The problem of fast railway travel will probably be tested to the utmost limits of practicability, within the next few years, upon the rival routes connecting New York and Philadelphia. The time of transit between these two important cities has of late (that is, since the completion of a second through line) been gradually cut down, until at the present time the trip is made on the fast express trains of both roads in a little less than two hours. The distance by either route is nearly the same being 88½ and 89$^{9}/_{10}$ miles respectively. The Reading Company operating one of these lines (the Bound Brook) now proposes to cut down the time of the trip between the two cities to 90 minutes, and for this purpose is engaged in testing the performance of a new engine built by the Baldwin Locomotive Works for the special purpose of making high speed. With this engine several experimental trips have been made in which the distance has been covered in 96 minutes, and so soon as it shall be in smooth running order, that is when the bearings work satisfactorily, the boiler is thoroughly freed from grease, and the exhaust apparatus adjusted in the most effective way, considerably better results may be anticipated, so that it is not unlikely that the trip between the two cities will shortly be made regularly in even less than 90 minutes.

When it is remembered that the line of these roads passes through a number of populous towns and crosses several long bridges where it becomes necessary to slow down considerably, it will be manifest that to accomplish this trip within the prescribed limit (90 minutes) a speed of more than a mile a minute must be maintained over a considerable portion of the road. This is very fast traveling; and requires, besides, very powerful engines, a road-bed in perfect condition, and the most complete system of operating the road. The maximum speed attainable, with safety, on railways is a question that has not yet been decided, but with properly constructed engines and good permanent way we do not think a speed of a mile per minute should be necessarily more dangerous than one of 30 miles per hour. In England a speed of 60 miles per hour is not at all uncommon on fast express trains, and the average speed on English lines is 46 miles per hour. There is no reason why we should not do as well, or even better.

To accomplish very high speed, however, requires considerable modification of the engine. The fast engines now in use have two pairs of coupled driving wheels, the largest of which are 5½ feet in diameter. When run at high speed the centrifugal force developed in the parallel rods becomes enormous, and much trouble has been experienced with these engines from the breaking of crank pins and coupling or parallel rods. In the new engines above referred to, these difficulties are met by certain modifications of construction which involve the dispensing with the use of coupling rods by having only one pair of drivers and making these of increased diameter, and by increasing the amount of heating surface. It may be taken for granted, if the Reading road cuts down the time of the trip between New York and Philadelphia, the Pennsylvania road will not be outdone by its rival, and the traveling public seems to be in a fair way to realize what is really meant by the highest speed compatible with safety which some of our railroad companies are fond of talking about.

Requirements of an Electric Lighting System.

So much has been said and written about the interesting subject of the comparative cost of gas and electric light, that the attention of the average reader has been distracted from points of equal, if not of much greater importance, which vitally affect the introduction of electricity for domestic illumination as a substitute for gas-light.

It may not be amiss, therefore, to briefly renew the practical requirements of a system of electric lighting which aims to rival the methods at present in vogue.

For the purpose of this *resumé* we may leave entirely out of the consideration, the question of the relative cost of the several methods of lighting, or, even assume that this question has been settled in favor of the electric light. Let us inquire then, what else is demanded of it.

It must be susceptible of perfect subdivision. The dazzling glare and great intensity of the electric arc, which is not objectionable in large open spaces, halls, factories, and public buildings, where it may diffused by suitably arranged reflectors and globes, it hardly need be said, is utterly unsuited for the wants of the dwelling. For this purpose, there is demanded not a single light of a thousand candles, but fifty lights of twenty candles; and not only this, but the luminosity of these fifty lights must be as much under control as that of so many gas lights, so that one or all may be used as required, and each shall be competent to yield such a proportion of its light up to the maximum of the twenty candles as may happen to be needed, just as a gas light may be turned up or down. All this, likewise, must be accomplished without waste of current, and the distribution of the current in its extensive ramifications from central stations must be effected with a small per centage of loss, just as coal gas is now conveyed in the mains and distributing pipes. The perventives against interruption of communication must be practically perfect in operation, and the mechanism of the lamps, must be simple to operate, and not liable to become disordered by reason of ordinary usage.

These are the salient requirements of a practical household, which any substitute for gas-light must possess.

From the foregoing statements, it will appear that the question of cost, which is now about the only theme of discussion in treating this question, is only one of many important practical elements which must be considered in the treatment of the subject, and by no means the most important one.

When the skill of our inventors shall have succeeded in meeting the practical requirements of a domestic lighting system, which we have endeavored to indicate in the preceding paragraphs, the question of cost will not, we think, prove to be a serious obstacle to the general introduction of electric lighting. For there are thousands of consumers who would be willing to pay well for the comfort of a light which is vastly superior to any other in point of purity. Between the present states, however, of the electric light problem and its development to a practical working basis, is a long stride, though we do not despair of seeing it covered.

Progress of Electrical Discovery.

It must be apparent to every attentive reader of the technical papers, that we are only on the threshold of discovery in the application of that protean agent, electricity, to useful purposes.

The electric telegraph, by which the obstacles that time and space had opposed to the wish and will of man, have been annihilated, may yet remain for centuries the crowning achievement of human genius; but since its perfection there have sprung up a host of other inventions scarcely less novel and useful. The telephone and the microphone have given us a command over sound analogous to that which we possess over light, for the telephone is to sound what the telescope is to light, and the microphone finds its analogue in the microscope.

The perfection of the dynamo-electric machine, upon which electricians may be said to have only fairly set to work, will make electricity in time as common an agent as steam for an infinite variety of uses, for it will remove the one obstacle that has hitherto hampered the extension of the uses of electricity, by cheapening the cost of its production. Already we observe the influence that even the imperfect devices of to-day have exerted in this direction, in the wonderful impetus that has been given to the solution of the problem of electric lighting, which, so long as we were restricted to the chemical battery for our supply of electricity, remained a scientific curiosity. It has already practically done away with the galvanic battery in the practice of the art of electro-plating and electrotyping, and within the past few months has taken the place of the battery in telegraphy. It has given form and substance to the thought that we may at no distant day be able to transmit to indefinite distances the inconceivable power of our huge waterfalls, and other wasted forces of nature, to do the work of our factories and work-shops. The electric railway is no longer a dream of the enthusiast, but is an accomplished fact; and even the astounding achievement of transmitting visible images by electrical currents has just been demonstrated to be practicable.

The new fields that are thus being opened by the course of electrical discovery, are so diverse and novel, that no one can tell where the lightning will strike next time, and with each successive advance the limits of possibility that are supposed to confine the achievements of the human intellect, are set further off.

Tysonite, a New Mineral.—Messrs. Allen & Comstock describe an anhydrous fluoride of cerium, lanthanium and didymium, from the neighborhood of Pike's Peak, which proved on examination to be a new mineral species. The distinguishing properties are: Color, pale wax yellow; streak, white; insoluble in muriatic and nitric acids; soluble in concentrated sulphuric acid with evolution of hydrofluoric acid; hardness, 4.5.5; specific gravity, 6.13; heated in a closed tube, it changes with decrepitation to a light pink. It was named "Tysonite" in honor of its discoverer.

A New Feed-Water Heater and Purifier.

The formation of scale in steam boilers is one of the ever-present difficulties that the steam user must contend with, and the subject of its prevention has been so much discussed, that it has been worn well-nigh threadbare. The result of all this discussion, if it has not entirely effected the solution of the difficulty, has at least gone very far in that direction in placing clearly before him the nature of the process of incrustation and the proper methods of counteracting it or lessening its quantity.

A few introductory remarks respecting the general features of this subject may not be altogether amiss before proceeding to the special subject of this article. The natural waters all contain dissolved mineral matter in greater or less quantity, and it is to the deposition of these materials upon the inner surfaces of the steam boiler that incrustation is due. The commonest of these chemical impurities are the carbonates of lime and magnesia and the sulphate of lime. There are many other saline substances contained in natural waters used for boiler-feeding, but they are generally very soluble, and therefore take no part in the formation of scale. The salts before named are the chief sources of the trouble. The carbonates named are held in solution by the carbonic acid which all natural waters contain, and when this solvent is driven off by the boiling of the water, the carbonates are completely precipitated, and adhere tenaciously to whatever surfaces they may fall upon. The sulphate of lime, the other scale-forming salt, is only slightly soluble in water, one part requiring about 500 parts of water; consequently, as the boiler water is evaporated, the solution rapidly becomes surcharged (or supersaturated) with the salt, and the excess is thrown down like the carbonates, and with the same adhering quality. The accumulation of these mineral deposits in time becomes so great as to render the proper heating of the boiler water impossible, and may even seriously damage the boiler by reason of the extra heating of the fire surfaces which their presence necessitates. How serious this trouble may become, will appear very clearly from the calculations of Dr. Joseph G. Rogers, who has given the subject careful study. According to this authority, the evil effects of scale are due to the fact that it is relatively a non-conductor of heat. Its conducting power, compared with that of iron, is as 1 to 37.5; consequently more fuel is required to heat water in an incrusted boiler than when it is clean. A scale one-16th of an inch thick will require the extra expenditure of 15 per cent more fuel. This ratio increases as the scale is thicker; thus, when it is $\frac{1}{4}$ inch, 60 per cent more fuel is needed; $\frac{1}{2}$ inch, 150 per cent more, etc. Abstractly then, to raise water in a boiler to any given hight, the fire surface of that boiler must be heated to a temperature dependent upon the thickness of the incrustation in an increasing ratio. Thus, to raise steam to a pressure of 90 pounds, the water must be raised to 320° Fah. In a clean boiler of $\frac{1}{4}$-inch iron, this may be done by heating the external surface of the shell to about 325°; but should half an inch of scale intervene between the shell and the water, it will be necessary to heat the shell to about 700°, or almost to redness.

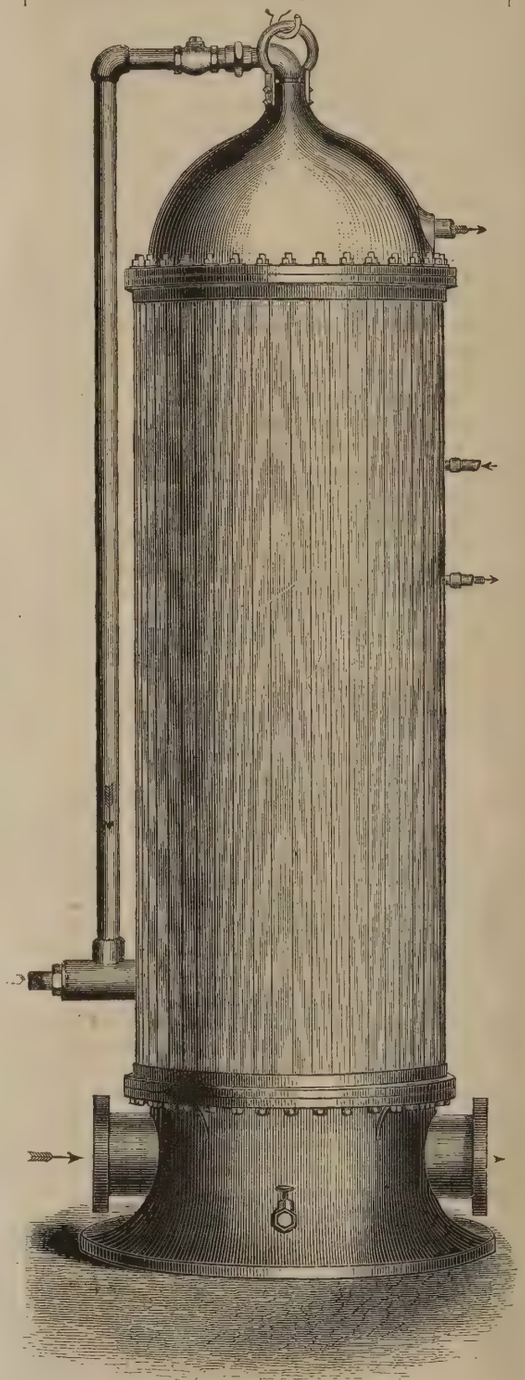


Fig. 1.—Strong's Feed-Water Heater and Purifier—Exterior View.

The injurious effects of such excessive heating continued for any considerable time, weakening the iron and predisposing it to explosion, need not be detailed. It is obvious, also, that the presence of scale renders slower and more difficult the raising, maintaining and lowering of steam.

To overcome these and other attendant evils of incrustation, various devices and plans, mechanical and chemical, have been suggested and employed, with greater or less success. One of the methods in common use is to cause the precipitation of the dissolved mineral ingredients previous to or after feeding the water to the boiler, by the addition of some chemical agent which an examination of the water has shown to be suitable for the purpose. These chemical precipitants will vary acccording to the nature of the water. This plan, however, though excellent, requires constant and intelligent attention.

Another plan, which has much merit, consists of a mechanical arrangement by which the operation of heating the feed-water and separating its sediment and the scale-forming ingredients is accomplished in one operation. Such arrangements are known generally as "Combined Feed-Water Heaters and Purifiers;" and of these we illustrate and describe a form which has received very cordial endorsement from well informed engineers and steam users. The apparatus in question, while performing the function of a feed-water heater, causes the precipitation, at the high temperature given to the feed, of the scale-forming mineral ingredients which are retained in the heater by a process of filtration, the mechanically suspended sediment collecting on the bottom of the heater.

By reference to the accompanying illustrations, the following description of the construction and operation of the heater will be comprehended: The apparatus shown in exterior and sectional views in Figs. 1 and 4 respectively, is cylindrical in form, and jacketed to prevent loss of heat. It is provided with a system of brass tubes (Fig. 4) for the circulation of the exhaust steam used for heating. The water is fed in at the side of the heater, near the bottom, and is heated by contact with the tubes, and, depositing its suspended earthy matter on the bottom of the chamber, rises. When it has reached the top of the system of tubes, it has acquired a temperature of nearly 212°. This temperature is already sufficient to cause some separation of the dissolved mineral matter; but to insure its more effectual precipitation, there is provided in the space above the tubes a coil through which live steam from the boiler is passed (Fig. 4), which effects a further increase in temperature, dependent on that of the steam in the boiler, and causes a more complete separation of the scale-forming impurities of the feed-water. The feed-water then passes upwards through a filter of packed charcoal (shown in Fig. 4), held between iron plates, which holds back all the mineral matter that has been separated. The purified and filtered water is then passed into the steam space of the boiler, through a passage seen at the side of the dome. Any scum that may rise to the surface of the water in the dome, is pumped back to the bottom of the apparatus by the ejector connecting the circulating pipe (seen in Figs. 1 and 4) with the bottom.

Figs. 2 and 3 are interesting as showing the difference in the appearance of deposits of sulphate of lime, and of the mixture of this compound with the carbonates, Fig. 2 representing the first named, and Fig. 3 the last.

Respecting the proper use and management of this apparatus, the inventor makes the following recommendations: The heater should be blown out,

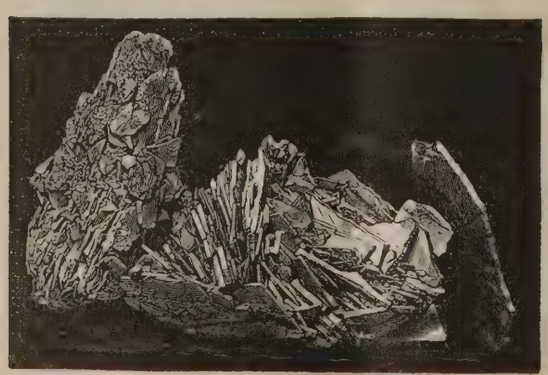


Fig. 2.—Sulphate of Lime Deposit.

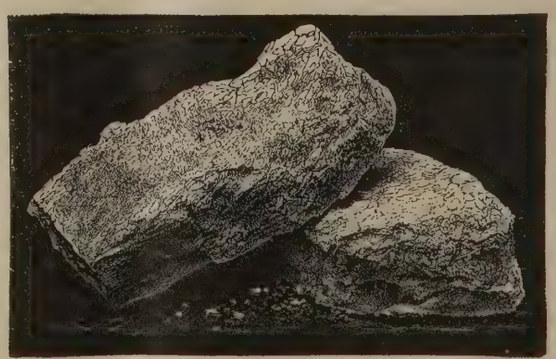


Fig. 3.—Sulphate of Lime and Carbonates.

when in use, at least every three hours; when this is done, the action of the water is reversed. The live steam from the boiler is blown back, thoroughly cleansing the filter, at intervals of three to six hours, and blowing all the sediment from the bottom. This will keep the filter clean, and prevent the necessity of renewing the charcoal oftener than once in sixty to ninety days. This cleaning process is easily accomplished by removing the keys in the dome flange, lifting off the dome, and taking out the filter, when it can be repacked, or replaced with one held in readiness for the purpose, in which case not more than thirty minutes are required. When the dome and filter are off, a hose can be used to wash out the heater from the top, which is equally necessary.

This heater is the invention of George S. Strong, and is manufactured by the I. P. Morris Co., Port Richmond Iron Works, Philadelphia, with sales warehouses in the principal cities.

Sheet-Iron Roofing.

We have in previous articles in this journal, had occasion to refer to the excellent qualities of various forms of sheet-iron roofing which are being largely introduced. When properly constructed, roofs of this class are admirably suited to withstand fire, wind and weather.

One of the simplest and most practical forms of roofing of this description, is that made by the Porter Iron Roofing Company, of 103 and 105 West Front street, Cincinnati, Ohio. This roofing is made from the best charcoal iron (No. 26 gauge). The sheets are 8 feet in length and 2 feet in width, weighing about 13 pounds each. The sides of the sheets are crimped in such a manner as to overlay and fit into a corresponding fold of the adjacent sheet, thus forming a continuous joint when the roof is finished. The ends of the sheets are united very simply, but effectually, by a simple fold or lap, and the whole firmly fastened down. This roofing is very simply applied, so that any person of ordinary handiness is able to put it down, and is shipped ready for use, including all fastenings necessary to complete it.

The manufacturers claim that it is the only metallic roofing that can be successfully used on rafters without sheeting, and for the sides of buildings without studding. It has been largely applied in this way on factories, foundries, saw and planing mills, depot buildings, etc., and being an effectual protection against fire, will be found useful for the erection of temporary buildings in cities where stringent fire laws are in force. The manufacturers cover the sheets with a double coat of metallic paint, and claim that with an occasional fresh coat, the life of the roof may be prolonged indefinitely. They further claim that the shape of the sheets and crimps provide for expansion and contraction, avoiding serious strain upon the fastenings, which may therefore be relied upon to remain secure in the most severe and variable climates. We may add, in conclusion, that these roofing sheets, being soft and pliable, can be readily cut into any desired lengths with ordinary tinner's snips, and bent and turned as may be found necessary in fitting around chimneys, fire-walls, etc.

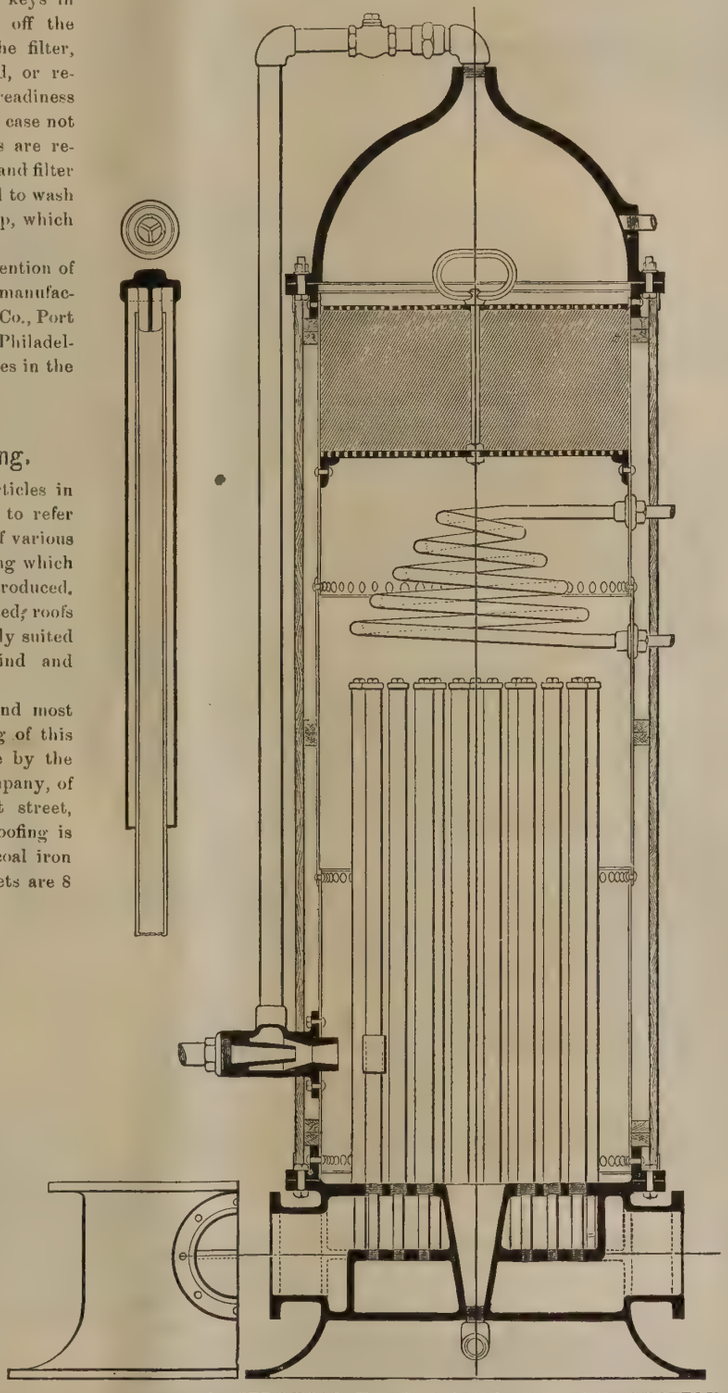


Fig. 4.—STRONG'S FEED-WATER HEATER—SECTIONAL VIEW.

Further information may be obtained by addressing the manufacturers as above.

The Audiphone.—A number of modifications of this simple instrument have been proposed. Mr. Rhoads, of Chicago, who first proposed it, made the instrument of a disk, of ebonite curved by means of strings at the back. Calladen, of Geneva, recommends a sheet of elastic cardboard 18 inches long by 10 inches broad, which he claims will give results equal if not superior to the ebonite instrument. An English experimenter affirms that the best material for the instrument to be polished wood veneer. He takes a piece of this material of oval shape (12x8½ inches), steams and bends it to the requisite curve. This plan obviates the necessity of strings, and is the simplest of any that have been proposed. It is very light and can be held between the teeth without any effect. Cheapest of all, probably, is the common palm leaf fan, held to the requisite curvature by means of strings attached to the handle.

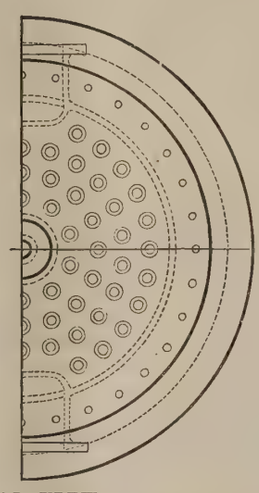
The United States Life-Saving Service.

The report of this branch of the government service, for the year ending June 30, 1879, makes a very favorable showing, and demonstrates very forcibly in the statistical presentation of its services, its value to the country. Briefly stated, the following are the chief points of interest respecting the work of the year above named: The life-saving establishments numbered 173 stations; these were manned by crews for different lengths of time, the longest term of service being on the dangerous coasts of Massachusetts, New Jersey and Maine, where they were on duty from September to April, both inclusive. On the Pacific coast there are but six stations, and these are manned entirely by volunteers. During the year in question, 219 disasters to vessels occurred within reach of the help of these stations. These vessels had on board 2,105 persons, of whom 2,049 were saved and 56 lost. The total value of these vessels and their cargoes is estimated at $2,887,886, and of this amount of property imperiled, more than half ($1,445,086) was saved.

The total cost of the service to the government, including salaries, buildings, expenses for repairs, apparatus, traveling expenses of inspectors, sustenance of rescued crews, etc., amounted during the year to $363,578.

A Large Pumping Engine.

The pumping engine at the Union Shaft, built at the Union Iron Works, San Francisco, by Prescott, Scott & Co., is the largest engine of the kind on the Comstock. Some idea of its size and power may be gained from the weight and dimensions of the cylinders and fly wheel. It is a direct-acting compound engine, and the two cylinders are upright, and placed so as to incline toward each other at the top. The initial cylinder is 65 inches in diameter, with 6-foot 9-inch stroke, and the other cylinder is 100 inches in diameter, with 8-foot 3-inch stroke. The larger cylinder weighs 43 tons, and smaller 30 tons. The fly wheel is 37½ feet in diameter, and weighs 110 tons. It revolves on a shaft that is 27 inches in diameter. The hub of this wheel weighs 15 tons. All else is on the same scale.



When this pumping machinery starts up, all the water likely to be found in the three mines working through the Union shaft—Sierra Nevada, Union Consolidated, and Mexican—will be readily handled. The water now flooding the 2,500-foot level of the Sierra Nevada mine will be taken out at once.

Striking it "Rich."—Among the lately reported curiosities taken from a Nevada mine, is a piece of sandstone, with grass roots still clinging to it, showing native silver all over its surface, petrified wood impregnated with ruby-silver, and a mass of chloride of silver, that assayed $8,000 to the ton.

Babcock & Wilcox's Water-Tube Boilers.

We present herewith in Fig. 1 a view of a nest of four boilers of the Babcock & Wilcox type, lately constructed for, and now in successful operation at the Standard Oil Company's refinery, Greenpoint, L. I.

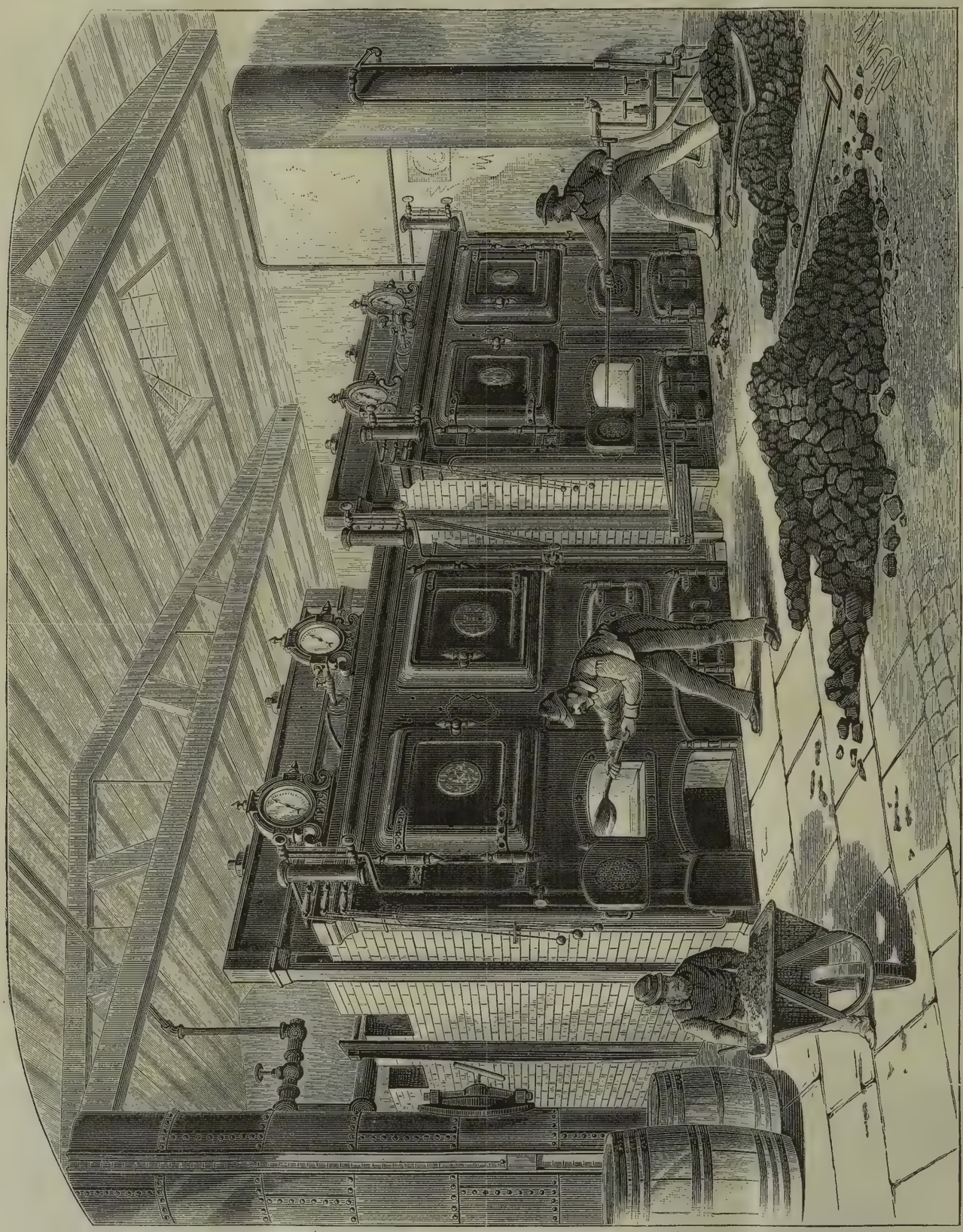


Fig. 1.—BABCOCK & WILCOX BOILERS AT THE STANDARD OIL COMPANY'S REFINERY, GREENPOINT, L. I.

Fig. 2 is a sectional view, showing the details of construction of this admirable steam generator. We add in what follows the salient points that distinguish this well-known boiler, which may stand as a typical representation of the tubulous steam boiler, combining as it does the distinctive feature of the sectional type of boiler—that is, immunity from destructive explosion, with certain decided merits—which have been found difficult to meet successfully in this form of steam generator.

By consulting the sectional cut, Fig. 2, it will be seen that it consists essentially of a series or nest of lap-welded tubes, inclined at a considerable angle, which are connected at both ends by vertical connections to a cylindrical drum or drums lying horizontally above them. These tubes are always full of water, the level of which is maintained at about the center of the drum or drums before named. Below, and in connection with the system of tubes, at the rear, is placed another and smaller drum for the purpose of collecting and retaining mud and sediment from the water.

The construction of this boiler insures a thorough circulation of the water, and the retention of any sediment only in that place where there is no circulation—that is, in the mud drum. The higher ends of the tubes being subjected to the hottest part of the fire, the escape of the steam takes place through the connections into the drum at the front end, while the cooler water descends through the connections at the back end—thus a constant and thorough circulation, as above noticed, is maintained.

One of the prime difficulties with the sectional boiler—namely, that of keeping the joints between the different members tight—is successfully met in the Babcock & Wilcox boiler, by making the end connections of single steel castings, into which the tubes are expanded,

the openings opposite the tube ends being closed by plates having ground joints, metal to metal, without any perishable substance between them. The whole structure forms substantially a triangle, of which the drums, back connecting tubes and inclined tubes form the three sides, a construction which will permit of considerable expansion without exerting more than a slight transverse strain in the connecting tubes front and back. Again, since the whole metallic structure constituting this boiler is suspended from girders resting upon iron columns independent of the brickwork, expansion and contraction may take place without fear of rupturing the walls, which is often a source of much trouble and loss with some forms of boilers. The disposition of the tubes is such as to provide for the greatest economy of fuel, a point which is accomplished by staggering the tubes, and by placing between them diaphragm plates and transverse walls, so as to cause the furnace gases to make three distinct excursions between the tubes before they are permitted to escape through the chimney.

Although this boiler has no superheating surface, the steam it furnishes is practically dry, a fact which has been abundantly verified in competitive tests. This feature is doubtless due to the large water surface or steam disengaging area and steam space in the drums. The large water surface likewise renders the maintenance of the water level an easy task.

The boiler is well devised with respect to accessibility for repairs. Hand-hole plates opposite the ends of the tubes, when removed, leave openings of the full size of the interior of the tubes. The large drums are provided with man-holes and plates, and the contents of the mud drum may be extracted by the removal of detachable bonnets on its ends. The exterior of the tubes are made accessible for the removal of dust, soot or ashes, by means of openings in the side walls. The fittings and fronts of these boilers, as will be seen by a glance at our engraving (Fig. 1), are tasteful in design; and, as a whole, it represents the results of much thought and study of the requirements of boiler practice.

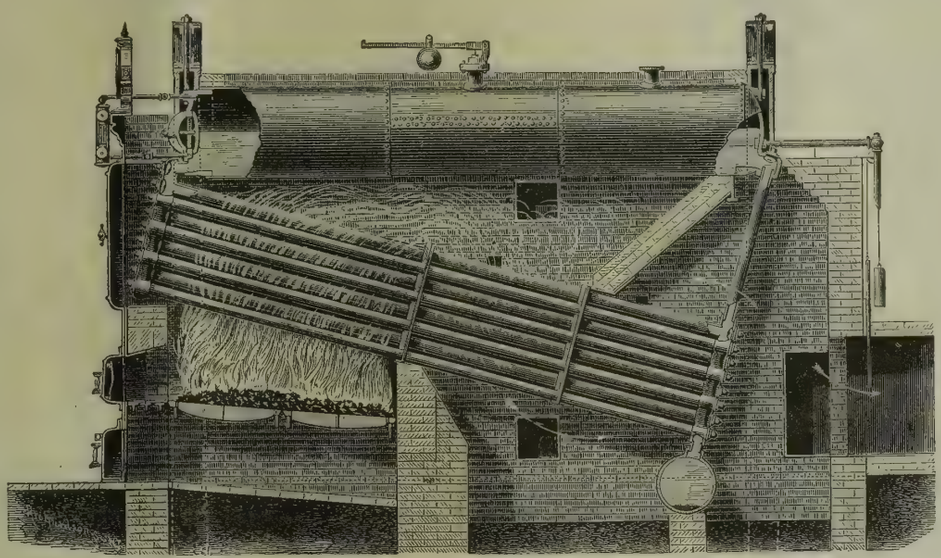


Fig. 2.—BABCOCK & WILCOX WATER-TUBE BOILER—SECTIONAL VIEW.

The makers of these boilers are Messrs. Babcock & Wilcox, of No. 30 Cortlandt street, this city, who may be consulted for further information.

Postscript.—"Straws," they say, "show which way the wind blows;" and it is somewhat significant to observe in the daily papers articles discussing the question of the advantages of water-tube as contrasted with shell boilers, on the score of safety against disastrous explosions. Such public discussion cannot fail to bring the meritorious features of this type of steam generator into the prominence they deserve. The Manufacturer and Builder has placed itself plainly and decidedly on record as the advocate of water-tube boilers, and hails with satisfaction such evidences of growing enlightenment upon a subject which so intimately involves the protection of property and of human life. As is the case with every substantial reform in the world of industry, progress in this direction will be gradual, since there are questions of expediency and business policy that will not be summarily put aside in its consideration.

We give below, in testimony of the preceding, a communication, from the New York *Sun* of recent date, which, while the author exhibits an inclination to make his comparisons a little startling and extravagant, is, on the whole, strong, pointed and sensible:

"To the Editor of the Sun:

"*Sir:* The people of the United States are strangely apathetic in reference to the horrible slaughter produced by steam boiler explosions. Nitro-glycerine is less dangerous than those huge cylindrical steam boilers which are exploding every month, inflicting death and agony upon the workmen of mills and factories and the people inhabiting the vicinity.

"The explosion which last Monday morning shook the city of Rome, N. Y., and mangled the bodies of Farr, Davis and Francis, again calls attention to this danger, and induces me once more to ask if we cannot be protected by law from such calamities, which involve the houses and people of the vicinity as well as the unfortunate workmen. At Rome the boiler was blown through the roof and to a distance of 400 feet, falling in a vacant lot. Everything in its course was destroyed. In a similar explosion in a planing mill at Philadelphia, on Front street, (June 27, 1879), the exploding boiler and the body of Dietel, the engineer, were hurled crashing into the second story of a neighboring house. Little Eva Long, sitting at her breakfast, was instantly killed, and her body was found with a fork in one hand and a broken cup handle in the other. There were five or six victims to this explosion.

"In the explosion at Low street, Baltimore (June 11), there were eight victims; a five-story building was wrecked, and the fronts of the houses wrecked or damaged for two squares along the street. That there were only eight victims was due to the absence of the workmen at the time. A boiler exploding along a crowded street would be as formidable as a discharge of artillery.

"Is there any necessity for these tragedies? Not the slightest. Steam is as safe as gas or compressed air in the proper machinery. A sectional boiler, being composed of tubes, is perfectly safe, but the huge cylindrical boiler contains an imprisoned earthquake. The boiler which exploded at Rome contained, at a pressure of 100 pounds to the inch, more than five and a half millions of pounds of pressure, and at a moderate working pressure between one and two millions of pounds. The workmen and citizens exposed to these tremendous forces depend for their lives on the soundness of a boiler which is continually burning and oxidating away, and upon the regular supply of water and the management of the furnace by a faithful, intelligent engineer, who is not called off from duty—all of which are uncertain things. They depend also on the cleanliness of the inside of the boiler, which is often entirely unknown. The boiler may be so incrusted as to allow the surface over the hot fire to become red hot—a condition which must in time produce an explosion. There are other modes, too, of producing explosions, and the cylindrical boiler has never yet been made safe, nor will it ever be. The boiler which exploded in Philadelphia had been inspected and certified by the Hartford Steam Boiler Inspection and Insurance Company, and its safety had been guaranteed under an examination forty-four days before the explosion.

"There is no safety but in a law prohibiting any dangerous accumulation of power in large boilers. A law limiting the diameter of steam generators to four, five or six inches, or imposing a very heavy license tax on dangerous boilers, sufficient to pay all damages, would remedy the evil and wrong no one; for the perfectly safe sectional boiler is really a more economical and scientific agent for the production of power. To license a boiler five feet in diameter and twenty or thirty feet long, is about as humane and wise as to license the keeping of a mad dog on your premises, if secured by a chain which the dog could not break unless the chain were old and rusty, or the dog very furious. Jos. Rody Buchanan.

"*No. 1 Livingston Place, May 11.*

Manufacture of Aluminum.

A NEW AMERICAN INDUSTRY.

We have pleasure in noting the fact of the establishment in this country, on what appears to be a very satisfactory basis, of the aluminum industry. The Pennsylvania nickel works, just put in operation in Philadelphia, lately made an interesting exhibition of metallic aluminum at a meeting of local chemists, which attracted much attention. The representative of this establishment made the statement that in the method of manufacture employed by them, the use of sodium in the operation of reduction was dispensed with, and that the metal was produced by a cheaper and more direct process, the details of which, however, were not communicated, as they have not been made the subject of patents. He further made the assertion that in the event of any considerable demand for this metal, or its alloys, its price could be materially reduced.

These same manufacturers produce an aluminum nickel-plating solution, which is intended for use as a substitute for the usual nickel-plating solution. It deposits with the battery, on iron, brass or copper surfaces, an alloy of aluminum and nickel, which is claimed to present a silvery white surface susceptible of taking a fine polish, and which is very permanent and indifferent to atmospheric influences. They also produce nickel-aluminum anodes for the same purpose. Of the other aluminum products made at this establishment, we mention, as having special interest for our technical readers, aluminum-iron for telegraphic wire and other uses; and aluminum bronzes.

Respecting aluminum-iron wire, we may state that the German telegraphic administration lately made a series of tests of its adaptability for telegraphic uses, and reported very favorably upon it. It has nearly the tensile strength of iron wire for equal sizes, is considerably lighter, and has considerably higher conductive capacity for electricity. It may be that we have in this application a direction in which aluminum may soon be utilized in great quantities. The admirable qualities of aluminum bronzes are already sufficiently well known to our readers, having been frequently referred to in these columns.

The introduction of this new industry into the country is a subject for hearty congratulation, and we wish the producers the success they anticipate and so fully deserve.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

NEW YORK CITY BUILDING ITEMS.

Abbey's Park Theater is to be enlarged and improved from designs of S. J. F. Thayer, of Boston.

On Eighteenth street, corner of Fourth av., a hotel, 53x144 feet is to be built for Joseph Wehrle.

The contract for the new building for the Bank of the Republic and First National Bank, New York City, has been awarded to Mr. R. L. Darrah, at a sum in the neighborhood of $375,000.

At an expense of $25,000, No. 20 North Washington Square is to be made into a first-class apartment house, containing suites of rooms to rent for $3,000 per annum; H. J. Hardenbergh is the architect.

H. J. Schwarzmann & Co., have drawn plans for a five-story store, 50x100 feet, which is to be built for W. Myers on the corner of Hester street and the Bowery, at a cost of $30,000. The building will be of brick with stone finish.

L. J. O'Connor is preparing plans for a school-house for the Cathedral Parish to be built on Fiftieth street, between Lexington and Fourth avenues. The building will be of brick, 80x100 feet, four stories high with basement; and will cost between $50,000 and $60,000.

Fulton Market has been condemned by the Inspector of Buildings as in an unsafe condition and dangerous to the limbs and lives of its occupants and of the persons who pass through. A bill has been introduced before the Legislature, providing for the rebuilding of the market by the Commissioner of Public Works, under the supervision of the Commissioners of the Sinking Fund. The bill was drafted by the Mayor and Comptroller of the city, and has been sent to Albany with a very strong memorial. It is expected that immediate action will be taken.

A large and handsome building is to be erected at Exchange place, Hanover and Beaver streets. The old Post Building on that site having been vacated by the Naval Office, its owners, Joel B. and John A. Post, have bought the adjoining office building, Nos. 18 Exchange place and 67 Beaver street, from the estate of W. B. Post, with the purpose of tearing down both structures and replacing them by a costly edifice. The plot which the new building will cover measures 85 feet 1½ inches on Exchange place, 53 feet 4 inches on Hanover street, 98 feet 2 inches on Beaver street, and 103 feet 4 inches on the rear line. The basement of the structure, which will be nearly on the level with the sidewalk, is to be 11 feet high, and the first story 18 feet 6 inches. Above the latter will be six full stories for offices, from 11 to 12 feet high each. The total hight of the building from the sidewalk to the flat roof, which is to be made of bricks or tiles, will be about 110 feet. A part of the roof will be surmounted by a tower two stories high, to contain water tanks and the rooms for the janitor. The basement is to be of Concord granite, and above that the building will be of light buff, almost white, brick, with terra cotta trimmings of the same shade. All the cornices, etc., commonly made of galvanized iron, will be of terra cotta. All the windows will be made with rounded arches, composed of ornamental work in terra cotta. The main entrance to the building will be on Exchange place. It is to be adorned with pilasters of polished dark granite, with white granite caps and bases, three on each side of the doorway. A round arch of brick and terra cotta, of fifteen feet span, will surmount the doorway, with handsome terra cotta spandrels. A less important entrance, of the same general design, will furnish access from Beaver street. The whole structure will be very substantial in its effect, and at the same time have a bright and cheerful appearance. The entrance from Exchange place will lead through a vestibule, with double doors, into a short, wide hallway, lined with brick and with terra cotta cornices and wainscot. The flooring in this and all the other hallways will be of tiles. On the right as one enters will be three swift elevators, a little beyond which the hall will lead into a courtyard with a glazed roof at the hight of the top of the first story. At the further side a descent of a few steps will lead to the Beaver street entrance. This courtyard will give access to all the principal offices in the center of the basement. The principal staircase in the building will run from the first hallway to the second story, while other stairways will connect the floors above. The first story will be constructed on substantially the same design as the basement, except that a bridge with a glazed floor will cross the courtyard and give access to the central offices. Each of these floors (the basement and the first story) will be so planned that it can be thrown into a single room, exclusive of the courtyard, or can be subdivided into a number of offices. The plan of the building above the ceiling of the first story is somewhat novel. Instead of containing the ordinary courtyard or well, the structure will recede in the center at that point on the south or Beaver street side, forming a courtyard enclosed on three sides but open on the south, measuring about 28x38 feet. The roof over the courtyard at the top of the first story will be nearly flat. By means of the arrangement indicated, all the offices of the building will receive direct light and air, through forty-five windows in each story, and every window will command a view of one of the three streets which the building will face. Each office floor can be divided into twenty-one offices, making in all a hundred and twenty-six in the six upper stories. The hallways will be wainscoted, and the upper half of all the hall partitions is to be of glass, as in the new part of the Equitable Building and the new Smith Building in Cortlandt street. The woodwork finishing will be of ash throughout. All the staircases are to be of iron, with slate steps and platforms, and the floors will be supported by brick arches and iron beams. It is designed to make the building as nearly fire-proof as possible in all respects. The architect is George B. Post. The structure is to cost between $200,000 and $300,000, and the contractors are required to complete it, ready for occupancy, by the 15th of April, 1881.

MISCELLANEOUS.

Lowell, Mass., has advertised for plans for a $7,000 school-house.

Waltham, Mass., will build a school-house at a cost of $20,000.

The town of Brewster, Mass., has voted $10,000 for a town hall.

The Board of Education of Chicago will erect a school-house, at a cost of $30,000.

H. K. Thurber of this city, will build a new canning factory, 36x150 feet, at Guilford, Conn.

A Masonic Temple is to be erected at London, Ont., at a cost of $70,000. Tracy & Durrand are the architects.

A building for the Farmers' and Mechanics Bank, of Middletown, Conn., to be built this summer, will cost $80,000.

A new church is to be built at Albany, N. Y., for the Calvary Baptist Society, on High street. W. M. Woollett is the architect.

The First Regiment National Guard of Pennsylvania are to build a new armory at the corner of Broad and Callowhill streets, Philadelphia. The building will cost about $120,000.

A post-office building to replace the one recently destroyed by fire is to be built at Milton, Pa. Twenty-five thousand dollars has been appropriated by Congress for that purpose.

The Milwaukee Chamber of Commerce is to have a new building in the modern Italian style that will cost $500,000, and is expected to surpass anything of the kind in the country except the St. Louis Exchange, which cost $2,000,000. It will have a campanile rising 160 feet.

A new car-house for the Rio Grande Railroad, at West Denver, Col., is to be built. It will contain fourteen stalls. The back wall will be 410 feet in length, and the front 179, with a depth of 72 feet 8 inches. The roof will be sloping, resting on the front wall 23 feet 8 inches high, and the rear wall 16 feet high. Together with the other buildings in the vicinity, it will form one of the most complete railroad shops in the West.

Homer Brothers, carpet manufacturers of Philadelphia, Pa., are putting up a large factory in that city, covering the block from Lehigh avenue to Somerset street, between Lithgow and Lawrence.

One of the largest manufacturing establishments in the country is now being built by the Pullman Palace Car Co., at a cost of $1,000,000. It is located near Chicago, on the Illinois Central Railroad, three-fourths of a mile south of the Kensington station. About 150 acres is included in the site, and will be laid out in drives and lawns, with two attractive parks. On one side is water transportation by Lake Calumet, and on the other the Illinois Central Railroad tracks, while but a short distance away is the junction of the innumerable roads leading into Chicago. The structures will be of brick and stone, having 1,130 feet of frontage and facing the double track of the Illinois Central Railroad. They will consist, first, of two parallel buildings for erecting shops 690 feet long and 87 feet wide. The central section, containing the offices and store-rooms, will be 100½ feet long and 100 feet deep, three stories high, with a tower rising to a hight of 146 feet. In the rear of these will be a series of four buildings, covering an aggregate frontage of 1,047 feet, with a general depth of 200 feet, forming the wood machine shops, blacksmith shops, varnish-room, repair shops and two erecting shops. Still back of these will be another erecting shop, 474x86 feet, a dry kiln 150x80, and a foundry 130 feet front and 200 feet deep. These buildings are compactly located as regards each other, making them convenient of access. The erecting shops will have stalls for 50 passenger cars and 100 freight cars at one time. Tracks running between the various shops will be provided with numerous turn tables, so that cars can be run in and out without switches. The Corliss engine is to be so situated that its thirty-five foot fly wheel will be in full view from the railroad, and the front of the building it occupies will be adorned with a large ornamental window. The monster engine cost originally $114,000, and to bring it on here from Providence, Rhode Island, where it now is, will require a train of thirty cars. Its normal capacity is 1,400-horse power, but it can be run up to 2,500-horse power. While at the Centennial Exposition this engine drove eleven acres of machinery. The engine will arrive at the new works, and be in operation September 1. The greater part of the machinery for the works will be new, and will cost, exclusive of the engine boiler, $300,000. All the buildings will be lighted with an electric light, and heated by steam. There will be 7,827,026 cubic feet to be warmed, which will require 230,536 feet of steam-pipe. In connection with the Pullman Palace Company's Works, and just north of them on the same grounds, is to be erected a manufactory for the Allen Car Wheel Company which is a consolidated corporation of all the paper car wheel interests in the country. The capacity of the works will be 20,000 car wheels annually. The buildings were planned by R. V. Allen, General Superintendent and inventor of the wheel, and are two in number. One will have a frontage of 364 feet, a breadth of 150 feet, and will be two stories high. The second building will be 100 feet front by 150 feet deep. The building will be graced with a tower. About one hundred men will be employed, and the power for running the works will be furnished by means of a shaft connecting with the Corliss engine. The cost will be about $200,000. To provide for the laborers to be employed in the two establishments the Pullman plans include the erection of cottage dwelling-houses, two stories high. S. S. Bedman, architect of this city, who drew the plans for the works, has in connection with them drawn plans for the dwellings. They will be located north of the works, and will be of brick with slate roofs.

The Allen Governor.

This apparatus has attained a well merited reputation as an effective device for regulating and controlling almost all kinds of link-motion and variable cut-off engines, and is specially referred to by its makers as being well adapted for controlling engines for running electric lights. It allows the speed of the engine to be altered at will, is simple in its construction, very durable, economical of fuel, and is very sensitive and at the same time powerful in operation.

The manufacturers claim that every engine to which it is attached, will run with the throttle wide open, and that when applied to an engine, no matter how sudden the changes in the power used, it should not vary more than one revolution so long as there is sufficient steam to do the work required of it.

The accompanying engravings and description will be of service in explaining its construction and action:

Figs. 1 and 2 show the governor in perspective elevation, while Fig. 3 gives a sectional view. Within a corrugated cylinder, which has small projecting ribs on its interior periphery, and which is partially filled with oil, a paddle-wheel is caused to revolve by a spindle passing through one end of the cylinder, driven by a belt communicating with the fly-wheel shaft. The tendency of the revolving paddle-wheel is to cause the cylinder to move in the same direction. On the opposite side to the revolving spindle is a trunnion or short spindle fixed to the cylinder, attached to which is a wheel carrying a set of movable weights suspended by a chain, the speed of the engine being regulated by the number of weights. Attached to the wheel, and keyed on the end of the short spindle, is a pinion revolving with the cylinder, and working in a toothed sector, the arm of which, being fixed on the spindle of the throttle valve, opens or closes it as the oil cylinder moves with the paddle, according to the variation of load thrown on the engine. When

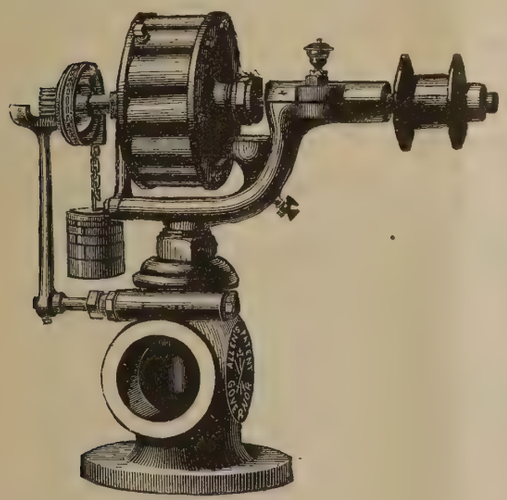


Fig. 1.—Governor and Valve.

used with a variable cut-off engine, the arm is attached direct to the cut-off.

From the above brief description of this governor, it will be seen that the weights are raised and lowered in a nearly vertical line, and, unlike those of other governors, remain the same at every point of their suspension. The high rate of speed used acts advantageously in making the governor very sensitive, and, all parts being lubricated, it works with the smallest amount of friction. The centrifugal or ball principle being entirely abandoned, the movable weights are suspended as easily at one point as another, by the action of the paddle-wheel in the oil cylinder; and from this fact, together with others peculiar to its construction, the makers claim to offer a direct saving of fuel and a considerable increase in the power of the engine. The peculiar action of this governor, which permits of the use of a valve of large area, thereby admitting to the engine cylinder the greatest possible boiler pressure at each stroke of the piston, has produced excellent results by being attached to old engines, greatly increasing their power, or effecting a direct saving in fuel, and in many instances doing both. In running an engine with this governor, with high or low pressure of steam and with all variations of power, the throttle is opened wide in the morning and remains so until closed at night, thus relieving the engineer from all labor and care, except keeping the engine oiled; and giving him time for other duties.

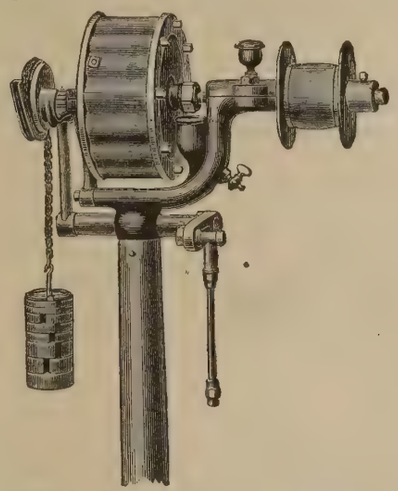


Fig. 2.—For Variable Cut-Off Engines.

Allen's Governor valve is constructed with a double disk in a tubular form, and is perfectly balanced, there being no spindle, as in the ordinary throttle valve, to interfere with its equilibrium. The valve is moved by means of a lever, and is opened and closed by a rocking motion of a steel spindle, which is covered with brass.

The workmanship of this governor is good, and the absence of springs and joints and all bearings subject to rapid wear, makes it very durable and not liable to get out of order.

The drip-cup under the stuffing-box receives all leakage from the cylinder, which may be drawn off by the cock in the bottom.

The enormous power developed renders this governor particularly adapted for slide valve cut-offs; and as it may be placed in any position without impairing its action, it makes an excellent governor for marine engines, and, for the same reason, for turbine wheels.

The manufacturers are the Allen Governor Co., of 98 Milk street, Boston, Mass., who will be pleased to give any further information that may be desired.

Condition of the Blast Furnaces of the United States, April 1, 1880.

The quarterly report on the condition of the blast furnaces of the United States, which indicates the condition of things on the 1st day of April, 1880, has just appeared. We give below a tabular statement gleaned from this report:

CONDITION OF FURNACES APRIL 1, 1880.

	In Blast.	*Out of Blast.*
Charcoal	102	154
Anthracite	189	40
Bituminous	140	66
Total	431	260

This statement shows a larger number of blast furnaces in operation than at any time since the year 1872, which was the last prosperous year of the iron trade, which in 1873 entered on the period of the recent prolonged depression. The following comparative table shows the condition of furnaces for the past four years:

	Number of Furnaces in Blast April 1,			
	1877.	*1878.*	*1879.*	*1880.*
Charcoal	57	60	68	102
Anthracite	82	97	89	189
Bituminous	79	95	84	140
Total	218	252	241	431

	Number of Furnaces out of Blast April 1,			
	1877.	*1878.*	*1879.*	*1880.*
Charcoal	220	207	191	154
Anthracite	142	129	137	40
Bituminous	126	122	135	66
Total	488	458	463	260

It may be accepted as a matter of course that there will be a large demand throughout the country for iron for a number of years, and our iron manufacturers will be kept fully employed in meeting this demand, unless by unwise inflation of prices by reason of speculation, the market should be thrown open again to such an inundation of British iron, as we have lately witnessed. An idea of the damage done to the iron trade by the late unreasonable inflation of prices, will best appear from the following statement of imports of iron and steel into this country for the three months of the current and two preceding years:

Exports of Iron and Steel from Great Britain to the United States for the Three Months Ending March 31,

Articles.	*1878.* *Tons.*	*1879.* *Tons.*	*1880.* *Tons.*
Pig iron	5,341	9,792	232,523
Old iron	569	1,601	99,362
Steel, unwrought	1,187	1,432	11,125
Tin plates	24,139	32,933	42,971
Hoops and sheets	156	235	14,421
Bar, angle and rod	1,626	715	23,827
Rails—iron and steel	109	1,184	43,367
Totals	33,127	47 892	466,696

The immense increase in our importations of these manufactures is well calculated to startle the reader who is competent to appreciate their significance, and they indicate that the reaction in prices of product and wages came not a day too soon to save the iron trade of the country from something very like a panic.

Metallic Packing.

Mr. L. Katzenstein, of this city, is the inventor of a

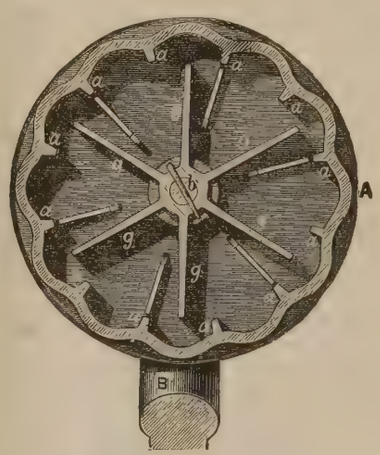


Fig. 3.—Section of Governor.

metallic packing in which he claims to have obviated the main objections to this style of packing. He makes use of a metal composition possessing sufficient hardness to insure durability, and soft enough not to injure the piston rod or valve stem with which it comes in contact. The packing consists of a number of rings, alternately convex and concave, which fit into one another, each ring being divided into two sections, and a gasket of soft packing placed on the top ring, to furnish the required elasticity. From the shape and position of the rings it is evident that the interior rings constantly tend to slide down on the exterior rings, and to press the latter out against the wall of the stuffing box, while they themselves are forced against the rod. The packing, therefore, is self adjusting, and a tight stuffing-box is obtained with the least possible friction. The manufacturers claim great durability for this packing, and cite instances where it has been in constant use from one to six years.

Explosion of a Compound Boiler.

DETERIORATION FROM CORROSION THE ALLEGED CAUSE.

From the monthly record of the Hartford Steam Boiler Inspection and Insurance Co., we select for illustration in this issue the case of a compound boiler, used in an iron furnace at a pressure of 70 pounds per square inch, and which exploded in January last, by the giving way of one of the plates of the "heater" or lower cylinder, at a longitudinal seam, which was also the boundry of a recent patch, which had been rendered necessary by corrosion.

The following are the more important details of dimensions, setting, etc.: The upper cylinder, 36 inches diameter by 50 feet long, was made of 19 courses of plates something more than 2½ feet wide. The lower cylinder, called the "heater," was 30 inches diameter by 39 feet long, made of 15 plates of the same width as those of the upper cylinder, by ¼ inch thick. The main boiler and heater were joined by 7 necks 10 inches diameter by about 11 inches long, placed on alternate courses of plates, beginning with the third course from the front end of each cylinder. This boiler was numbered "3" in a set of three (facing the front ends and numbering from left to right), which were joined to the same steam drum by nozzles on their ninth courses immediately over their middle necks, and suspended by three hangers on each boiler in the chamber formed by the masonry which enclosed them, as high as their water level in the upper cylinder. The front and rear ends of the main boiler and the front end of the heater passed through the respective walls of the chamber. The hot gases from the furnaces were admitted by a pipe or pipes through the rear wall about on a level with the center of the heater, whence they passed directly to the chimney flue at the front.

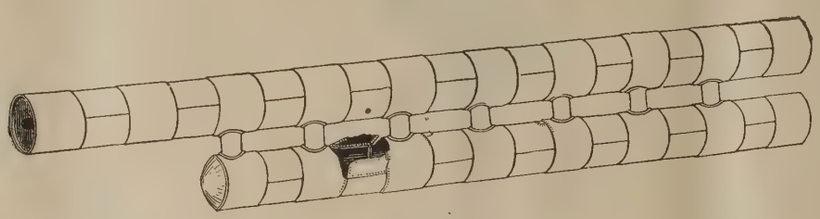


Fig. 1.

Referring now to the engravings, Fig. 1 gives a view of the boiler, showing the location of the rupture in the heater or lower cylinder, as above stated. The seam seen below the ruptured edge, it is important to notice, is the boundry of another patch, and it was at the junction seam of the two plates that the initial rupture occurred. The portion of the plate, with its two patches, forming a girdle of the cylinder, was completely separated, and is shown in Fig. 3 on the opposite page, on which dimensions are marked. Fig. 2 is a perspective outline from a photograph of a portion of the two cylinders and their necks, as they appeared after the explosion.

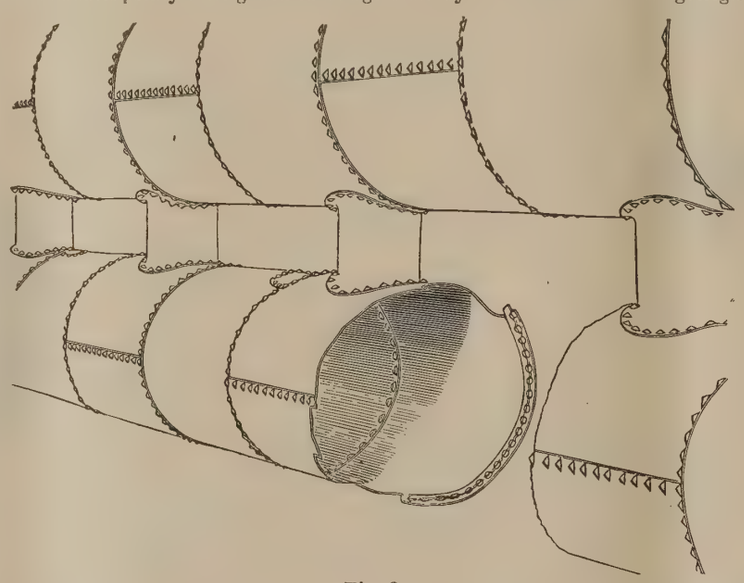


Fig. 2.

An examination was made after the explosion, of the metal of the pieces marked with the star and the crossed circle, Fig. 3. The intermediate piece had probably been carried off by visitors and could not be found. The result of this examination showed that the metal was quite unfit for use in any part of a steam boiler. It broke into three pieces and cracked in many places when the attempt was made to straighten it cold upon an anvil (see Fig. 4), and the pieces *e* and *f*, which broke off completely, showed a coarse crystalline fracture like zinc. A piece taken from the adjoining original plate, to which the patch had been riveted, showed that it was little if any better than the patch—in fact, was so brittle and inferior as to render the whole lot of heaters made of it unsafe to use.

In considering the cause of this explosion, the conclusion is forced by the facts that it is to be ascribed to the extensive deterioration of the metal, caused by corrosion. In this case the boiler was heated by the waste gases from the furnace. The official opinion of the company respecting this case, is accompanied by the statement that the deterioration from corrosion of the parts of compound boilers, such as mud drums, heaters, water bottoms, and the like, that are located below the active generating surfaces of the boiler, is a notable feature in their experience.

It appears to be probable in this case that the manner of supporting the boiler may have had some influence in straining the joints and rendering them leaky, thus determining the points of most active corrosion of the leaky seams, which would continually supply the necessary moisture to condense the acid vapors of of the furnace gases upon the surface beneath. And in view of all the attendant circumstances, the opinion seems to be fully justified that the corrosion was promoted by leaks, that the leaks were caused by the straining of the joints, and that the patch which gave way had been subjected to violence greater than its strength would warrant, either when being put on or subsequently thereto.

Reclamation of Arid Lands by Artesian Wells.

Congress has been memorialized to appropriate the sum of $50,000 for the purpose of testing the practicability of irrigation on a large scale by means of artesian wells distributed throughout the arid regions of the United States. There are, it is estimated, not less 900,000,000 acres in the arid region, which includes portions of Arizona, Dakota, Idaho, Montana, New Mexico, Utah, Wyoming, Colorado and Nevada, and lesser sections of California, Kansas, Nebraska, Oregon, Washington Territory and Texas, and of these less than one per cent has been sold by the government, nor are extensive sales likely under present conditions: Two hundred millions of this total consists of mountain land, which, even with abundance of water, would never be available for agricultural uses; and about as much more consists of "lava beds," "bad lands" without soil or vegetation, and desert plains of drifting sand, leaving about 500,000,000 acres of plain and rolling land capable of profitable utilization, and only wanting water. The existing rivers and streams, if intelligently employed for irrigating this land, could not be made to do more than reclaim about 3 per cent, and the rest must always remain of little or no value, unless some other means of supplying them with the needful element is found.

In the State of Colorado alone, it is affirmed, there are not less than 40,000,000 acres capable of high cultivation if properly irrigated. To meet this crying want, the government has been urged to test the practicability of irrigation by artesian wells—a suggestion of much interest, which we should greatly desire to see carried into effect, though it might not prove to be of such extended utility as its sanguine advocates think. Nevertheless, the suggestion has sufficient plausibility to warrant the serious consideration of Congress, and since the practicability of the experiment may be fairly tested by the expenditure of a small sum of money, it should be made; and should it prove to be a failure, the money will not have been altogether wasted, for it is often of value to know that a thing cannot be done. And should it prove to be only reasonably successful, there will be millions of private capital forthcoming to convert every promising locality of the regions in question into a sieve.

The accounts given in the public prints, take substantially the view of the case that we have assumed. We give a sample extract in conclusion: "The people of the West desire Congress to appropriate $50,000 for boring artesian wells, the land being the property of the government. Private enterprise will not undertake the experiment, but let the practicability of irrigation by artesian wells once be established, and private purchasers will be found who will carry on the work of boring at their own expense. Some of the ablest geologists in the country have expressed the opinion that flowing wells can be obtained in many localities on the plains east and west of the Rocky Mountains, and the Commissioner of Agriculture, under whose auspices special attention has been given to the subject, has recommended that artesian wells be sunk."

Statistics of the Iron and Steel Industry.

Mr. James M. Swank, the Secretary of the American Iron and Steel Association, has nearly ready for distribution to members of the association, a directory of the iron and steel industry of the United States. This compilation will give the name and location of every blast furnace, rolling mill, steel works, forge and bloomary in the country, with full information concerning each, especially with relation to the character and capacity of the same. From this valuable source of information we glean the following leading statistics: Number of completed blast furnaces, March 1, 1880, 697; number of blast furnaces building, 23 bituminous, 12 anthracite, 9 charcoal, total, 44; annual capacity of completed furnaces, in pig iron, net tons, 6,500,000; annual capacity of 203 bituminous furnaces, net tons, 2,825,000; annual capacity of 228 anthracite furnaces, net tons, 2,600,000; annual capacity of 266 charcoal furnaces, net tons, 1,075,000; number of completed rolling mills and steel works, 382; number of rolling mills and steel works building, 10; number of single puddling furnaces (a double furnace counting as two single ones), 4,467; number of heating furnaces, 2,419; number of trains of rolls, 1,397; annual capacity of rolling mills in finished iron, net tons, 400,000; annual capacity of rail mills in heavy rails, net tons, 2,150,000; number of rolling mills having nail factories, 73; number of nail machines, 4,152; number of completed Bessemer steel works, 11; num-

ber of Bessemer steel works building, 2; number of Bessemer converters (22 completed, 10 building), 32; annual capacity in ingots, net tons, completed converters, 1,250,000; new converters, 500,000; total, 1,650,000; number of completed open-hearth steel works, 22; number of open-hearth steel works building, 3; number of open-hearth furnaces (33 completed, 6 building), 39; annual capacity in ingots, net tons—completed furnaces, 225,000; new furnaces, 50,000—total, 275,000; number of completed crucible cast steel works, 35; number of crucible cast steel works building, 3; number of steel melting pots in the completed works, 3,080; annual capacity in ingots, net tons, 90,000; number of miscellaneous steel works, 9; number of steel manipulating works, 31; number of completed forges (one building), make wrought iron from ore, 69; annual capacity in blooms and billets, net tons, 85,000; number of completed bloomaries (one building), make blooms from pig iron, 60; annual capacity in blooms, net tons, 80,000.

A Locomotive Engine Fired with Petroleum.

An experimental trial was lately made on the Long Island railroad of a locomotive engine fired with petroleum, the special device being known as a "hydro-carbon retort," invented by Dr. Charles Holland. The claims made by the inventor are that his mode of firing is not only more economical for steam generation for every form of engine, but that it has the special advantage for locomotives that it generates steam very rapidly, and does away entirely with the smoke and cinder nuisance.

The invention consists of a retort of cast iron, and contains four chambers, two for water and two for oil. In starting the fire to first generate steam while the water in the boiler is cold, the water chambers of the retort are supplied from the water tank on the tender. As soon as sufficient steam is raised, say ten pounds, the water supply is shut off, and hot water allowed to flow in from the boiler. The steam, being first superheated, is then brought in contact with the gas flame generated from the oil. The inflow of oil and water by the four separate induction pipes into the four separate chambers of the retort is controlled by four valves, which the fireman can govern at will as readily as a common gas jet.

The theory of the inventor, as announced in the published accounts of the trial (which is said to have been very satisfactory), is that the steam, coming in contact with the oil flame as described, is decomposed, and that by the liberation of its elements, oxygen and hydrogen, a much more perfect and intense combustion is obtained than could otherwise be secured; and we observe in the account an implied adherence to the common fallacy that there is a theoretical gain involved in the decomposition of water by a reducing flame (like that of the oil) and the subsequent combustion of the products of the decomposition.

We have no doubt that a most intense heating effect can be produced by an arrangement like the foregoing is described to be; and provided there are no fatal mechanical defects in its design, we see no reason why the invention should not be a successful and very useful one. But it is as well, in speaking of its merits, to explain its principles correctly, and to that end it may be proper to say that the economical advantages attending the burning of oil vapors in contact with steam (which are admitted to be considerable), result wholly from the very perfect intermingling of the air with the hydro-carbon vapors which the steam jet effects, thus rendering the process of combustion far more perfect than can be secured by other methods. It should be recognized by inventors that the energy expended in the decomposition of any of the steam under such circumstances (and it is probable that some decomposition does take place), robs the flame of just so much of its heating power as will be subsequently given out by the combustion of the decomposed water elements, provided that nothing were lost in the operation by conduction, etc. The economical advantages gained, therefore, in such devices as that of Dr. Holland, must be attributed simply to the mechanical effect of the steam jet in effecting a more perfect combustion of the oil vapor.

Aside from this, the trial of this engine is an event of considerable interest, and we will be pleased to hear more of its performance than has yet come to our knowledge.

The portion of the account of the trial trip relating to the engine's performance and capabilities, is as follows: "The engine was coupled to a car in which the party took their seats, and a run of six miles out and return was made, with three gallons of naptha, costing three cents per gallon. Not a particle of smoke or cinders could at any time be seen, nor smell of gases, and a large part of the time it was found necessary to use but two of the chambers of the retort, and then even to not more than one-fourth their capacity, so that an enormous reserve force was in readiness for any emergency, such as ascending heavy grades. In descending grades the fire can all be instantly shut off, and so remain until a level grade is reached, when two chambers of the retort can be instantly relighted, and so continue until a heavy grade is reached, when the other two chambers can be instantly relighted, if required."

Fig. 3.

Fig. 4.

The application of petroleum as fuel in many different situations is growing to be quite common, and as it has all the merits of gaseous fuel, which have frequently been pointed out in this journal, we look upon its more extended introduction as not at all unlikely.

A Proposed School of Forestry.

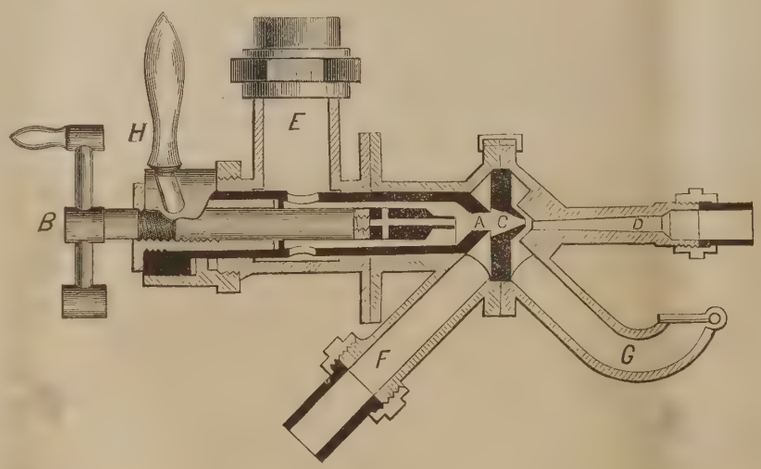
A bill for the establishment and maintenance of a school of forestry at St. Paul, Minn., has been introduced in the Senate by Senator McMillan. It would seem to be time that some attention was paid in this country to the conservation of our forests, and this proposed school seems to be a step in that direction. As a means of supporting the proposed school, the government is called upon to grant 300 sections of the public lands of the State, to be selected by an agent appointed by the Governor, with the approval of the Secretary of the Interior. Not more than two sections are to be taken from any one township, and those selected are not to be mineral lands. The sections are then to be sold, and the proceeds invested in United States or other safe bonds, at not less than 4 per cent interest. The capital is never to be diminished, and the interest is to be appropriated for the endowment and support of the school, which shall give instruction in the science and practice of forestry, as adapted to the climate and soil of the State. Ten per cent of the interest may be set apart for the purchase of lands for experimental out-stations for tree culture on prairie lands and forest culture on lands, when such experiments shall be authorized by the Legislature. No part of the fund or interest to be used in buying, erecting,

or repairing the school building, and unless the school is provided with a suitable building and 40 acres of land for experimental timber culture, within 8 years, the grant is to cease. The State must employ at the head of the school a person of known qualifications in the science and practice of forestry, and the tuition is to be free. Pupils are to be admitted from any State. An annual report of the progress of the school and the results of its experiments is to be filed with the Librarian of Congress and the Commissioner of the General Land Office.

Experiments with a Steam Injector.

The Committee of Science and Arts of the Franklin Institute recently published in the *Journal* of the society the results of an exhaustive series of experiments with an improved form of steam injector and ejector, devised by Mr. J. H. Irwin, (well known as the inventor of the tubular lantern), which are worthy of special notice.

The instrument investigated by the committee is the outcome of a number of years of careful study and experiment on the part of its inventor, and embodies in its construction certain principles which he claims to have observed and demonstrated to be necessary to observe to develop the best and most economical action of this type of apparatus. The law enunciated by Mr. Irwin may be briefly stated to require the employment of certain angles and set dimensions of the interior working parts, of which the following are the most important: Taking the lesser diameter of the combining cone as the standard of measurement of the instrument, and calling it 1, the larger diameter and length of the combining cone will be 4, the diameter and length of jet opening in steam cone will be 2, the smaller diameter of receiving cone 1, its larger diameter 2, and its length 16, while the diameter of the starting steam jet will be 0.5. These are the principal dimensions of Mr. Irwin's apparatus, but its construction embodies some other determined dimensions of universal applicability, of which the more important are briefly noticed. The water supply pipe and over-flow are set at an angle of 45° to the axis of the instrument, an adjustment which is claimed to materially increase the power of augmentation. Permitting the free entrance of the external air at and through the overflow is affirmed to give a clear gain of one atmosphere, and the fact was demonstrated by placing the thumb over the orifice of the overflow, when the index of the gauge immediately fell back about 15 pounds, and advanced to its former position when the obstruction was withdrawn.



Steam Injector.

The details of the experimental tests of the committee, which were conducted with the utmost care, are recorded in an elaborate table, which we regret is too long to be given in our columns. For the full report therefore, we must refer our readers to the *Journal of the Franklin Institute*, and content ourselves with the presentation of the more important of the committee's results, and a brief sketch of their mode of making the tests.

The water supply for the injector was received in a circular tank, capable of holding 400 gallons, which was mounted on a platform scale capable of weighing 6,000 pounds. The water delivered by the instrument was led into another tank similarly mounted on a platform scale, and thermometers and gauges were suitably placed in positions convenient for observations of temperatures and pressures. A Wiegand boiler, capable of giving 105 pounds of steam, was used in the experiments. The injectors tested were selected at random from a number of the same pattern; and in carrying on the tests, the inventor was assigned the duty of running his apparatus, while the members of the committee were each assigned to some special duty in noting the results of each experiment.

The conditions of the experiment having been announced by the chairman, each one was made by the operator starting his instrument; when in proper order he gave the signal, the chairman then gave the word to start and stop, and the observations were noted, each by its special observer. In the first experiment, with steam at 15 pounds above atmosphere, 471.5 pounds of water were lifted 7 feet 6½ inches, and 492 pounds of steam and water combined were delivered in a quarter of an hour (the duration of each test), thus showing that 20.5 pounds of steam were used to do the work. The temperature of the feed was 62.5° Fah., and that of the delivered water 104°. This experiment gave 23 pounds of water lifted for each pound of steam, and though higher results were obtained, the instrument worked better at low pressures than at high ones.

With steam at 105 pounds, only 7.5 pounds of water were delivered for each pound of steam used. The injector was found to adapt itself to a great variety of conditions. The experiments ranged from 105 pounds above atmosphere to 15 inches of vacuum, the instrument still working. An augmented pressure of 330 pounds was gained by 90 pounds of steam; and at 10 inches of vacuum an augmented pressure of 10 pounds was gained. Feed at 122° Fah. was lifted 19 inches and forced by 30 pounds of steam against an equal pressure. Water was lifted 21 feet with 40 pounds of steam and forced against 60 pounds of pressure; and other striking performances were made by the same instrument without a particle of change or alteration.

In all these varied tests, the instrument generally responded promptly, and ran through the allotted time (usually 15 minutes) without readjustment.

From the results of their experiments, the committee conclude that "the information gained in regard to this injector is highly important in the cause of science, and that Mr. Irwin has contributed a valuable improvement in the manner of constructing injectors, increasing their power of augmentation to above twice that of the pressure of steam used for practical working, without waste, and about four times with waste at the overflow," apparently demonstrating the general law that the lower the steam pressure employed the higher can the proportional pressure be carried.

Without going into additional details, the committee's report appears to establish without question that Mr. Irwin has made a really valuable contribution to the principles involved in the action of the steam injector.

DEADENING NOISES OF WORKSHOPS.—To those who carry on any operations requiring much hammering or pounding, the following, from the *Workshop Companion*, will be a great relief. 1. Rubber cushions under the legs of the work-bench. *Chambers Journal* describes a factory where the hammering of fifty coppersmiths was scarcely audible in the room below, their benches having under each leg a rubber cushion. 2. Kegs of sand or sawdust applied in the same way. A few inches of sand or sawdust is first poured into each keg; on this is laid a board or block, upon which the leg rests, and around the leg and block is poured fine dry sand or sawdust. Not only all noise, but all vibration and shock are prevented; and an ordinary anvil, so mounted, may be used in a dwelling house without annoying the inhabitants. To amateurs, whose workshops are usually located in dwelling houses, this device affords a cheap and simple relief from a very great annoyance.

What is the Most Economical Point of Cut-Off for Steam Engines.

Prof. Wm. D. Marks, of the University of Pennsylvania, has undertaken to grapple with this perplexing problem, and in a paper presented to the Franklin Institute, lays down a simple law which he claims will hold good, both with high and low pressure engines. He bases his demonstration upon mathematical reasoning, which we fear would be somewhat uninteresting to the great majority of our readers, hence we simply present the conclusions which he arrives at; and as his alleged discovery will doubtless call forth considerable comment and discussion on the part of mechanical engineers, we will await the result of this announcement to the profession with special interest.

Some writers, according to Prof. Marks, have recommended that the point of cut-off should be determined by dividing 2 by the square root of the steam pressure in pounds; others have passed the point over in silence; and still others have endeavored to determine the point of cut-off, giving the most economical results, by many and costly experiments.

The rule which Prof. Marks lays down is at once simple to understand and apply—it is as follows: The fractional part of the stroke giving the most economical point of cut-off for a steam engine, equals the absolute back pressure per square inch divided by the absolute initial pressure of the steam per square inch. In applying the rule, the following example will be sufficient:

Example.—In a condensing engine, let the gauge pressure =45 pounds, and the absolute back pressure =3 pounds; then the most economical point of cut-off will be

$$\frac{3}{45+15}=\frac{1}{20}\text{th of the stroke.}$$

If the engine is supposed to be non-condensing, and the absolute back pressure =15 pounds (1 atmosphere), we have the most economical point of cut-off

$$\frac{15}{60}=\frac{1}{4}\text{th of the stroke.}$$

Prof. Marks promises a more exact demonstration of his rule in the near future, but affirms that engineers will find the method here described to be simple and exact enough for all ordinary practical purposes.

DOES GAS INJURE BOOK-BINDINGS?—*Apropos* of our late reference to this topic, in which we placed on record the opinion of Prof. Walcott Gibbs that coal gas was not the cause of the deterioration of book-bindings, we glean that Prof. J. R. Nichols takes the opposite side to that occupied by Prof. Gibbs, and considers that gas does injure book-bindings by the sulphuric acid produced in its combustion. In the *Journal of Gas Lighting* for February 17th, this view is combatted by the publication of a report by Charles Ekin, F.C.S., of analyses of a whitish powder found *under* the labels of certain volumes from the Royal Literary and Scientific Institution of Bath, England. Some of the books had

been exposed to the products of gas, combustion and some had not, yet both sets were affected in the same way, and the powder was of the same general composition—acid ammoniac sulphate in both cases. The truth seems to be contained in a foot-note, in which it is stated that sulphuric acid has been used in large quantities in tanning hides, and is the source of the troubles hitherto assigned by many to sulphur in gas.

Improved Apparatus for Generating Ozone.

The importance which has always been attached to the question of divising means for generating ozone in considerable quantities, has been urged not solely upon scientific grounds, but partly on account of the presumable technical value that might attach to the discovery, because of the very eminent oxidizing powers of this singular modification of oxygen. Whether or not these expectations have any substantial basis, bids fair to be settled definitely before long, since the late researches of Prof. A. R. Leeds, of the Stevens Institute, who has succeeded in so materially improving the methods of manufacturing ozone, that at present there would appear to be no difficulty in the way of obtaining it in large quantities from generators that can be arranged to keep up a constant supply of ozone for days. Even with such decided improvements upon earlier methods, however, it must be borne in mind that only a relatively small percentage of the oxygen passed through the apparatus is changed to the condition of ozone; but the percentage so converted is so much greater than that hitherto obtained, that the improvement over older methods is a considerable one, and should the anticipations of the technical importance of this agent be only partially realized in practice, the stimulus to still further improvements in the methods of producing it in large quantities will doubtless lead to still better results.

The object of Prof. Leeds' inquiries was, as he states, not to ozonize to a maximum a small volume of confined gas with the view of studying the properties of the resulting product, but to ozonize to a maximum a *current* of air or oxygen, with the view of studying the reactions produced by it in the various substances with which it was brought into contact.

With this object in view, Prof. Leeds has experimented with the various forms of ozonizers heretofore proposed, and as the result of his work, describes two forms of apparatus, one of them chemical and the other electrical, which have afforded him very good results. These methods we describe and illustrate in what follows:

The first apparatus (Fig. 1) is an improvement on the method of generating ozone by the slow oxidation of phosphorus partly immersed in water, which most of our readers will recall as a well-known lecture experiment. Prof. Leeds obtained much better results by substituting for the water usually employed, a mixture of potassium bichromate solution and sulphuric acid in which the sticks or cakes of phosphorus were partially immersed.

By consulting Fig. 1, the apparatus will be found to consist of several bells—the number of which can be multiplied at will—cemented into heavy brass caps. Through these caps, and the paraffined corks beneath, connecting tubes of heavy glass are passed, and a sliding glass rod, which terminates below in a horizontal circle. The latter carries a disk of sheet-lead, with a slot permitting its removal. The caps are attached to a board, having a longitudinal opening, to permit of the passage of tubes, etc., and this again is attached by chains to the axle, shown above, which permits them to be raised and lowered by the crank. Each bell, furthermore, is provided with a thermometer, the bulbs of which dip just below the surface of the liquid.

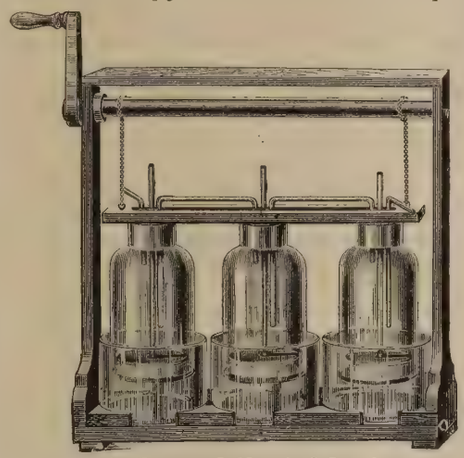


Fig. 1.—Improved Chemical Ozonizer.

The connections between the bells are made of flexible tubes of a special variety of kerite made by Mr. Day, and which is not affected by the ozone. With this apparatus, and by simply drawing the air through the bell-jar so as to bring it into contact with the before mentioned materials—that is, phosphorus partly immersed in a mixture of sulphuric acid and potassium bichromate—Prof. Leeds is enabled, with three 6-liter bells, to obtain a constant current of ozonized air, or oxygen, carrying 2½ milligrammes of ozone in the liter, or about two-10ths of one per cent of the total weight of the air, or about one per cent of the weight of the oxygen the air contained. This is of course relatively a small percentage; but when it is remembered that the apparatus can be attached to a water pump, and caused to act day and night, the yield of ozone may be indefinitely increased. The best results were obtained at a temperature of 75° Fah.

The second apparatus, which we illustrate in Fig. 2, is a modification of the Siemens electrical ozonizer. *a a* are small sulphuric acid wash-bottles; *b b*, corks dipped in melted sealing-wax; *c c*, outside coating of tinfoil; *d d*, connections of paraffined cotton cloth; *e e*, rings of glass; *p p*, copper strips connecting with inner coatings and one pole; *n*, copper strip connecting the outer coatings and the other pole. The apparatus shown consists of six induction tubes (or elements), each made of a tube of thin, hard glass (60 centimeters long by 21 millimeters inside diameter), provided with inlet and outlet tubes. The space between these two latter tubes is coated with tinfoil. The inside tube is a little longer, one end being rounded; the other, after the interior has been coated with tinfoil, is closed with a dry cork, through which the copper connecting wire passes. The space between the rounded end of the inner tube and the outer tube is nearly filled by a ring of glass, cut from a tube of suitable bore, and the space closed by dipping in melted sealing-wax. In coupling the elements together, the exit tube of the first is joined to the inlet tube of the second by a wrapping of strips of muslin, which are bound by flower wire and made gas-tight by a coating of paraffin. The first inlet tube and the last exit tube are made of parts of small sulphuric acid wash-bottles, by means of which the kerite connections are protected from backward diffusion of the ozonized gas on the one hand, and a convenient attachment is made on the other.

With this apparatus, set in operation by passing sparks from an induction coil through the battery, and drawing a uniform current of air or oxygen through it, Prof. Leeds obtains a constant supply of ozone in considerable volume, and the supply may be kept practically constant for months. Operating with oxygen, the average yield, with the battery in good condition, is given at 72 milligrammes per liter, or about 5 per cent, which would correspond to about 1 per cent when air is aspirated.

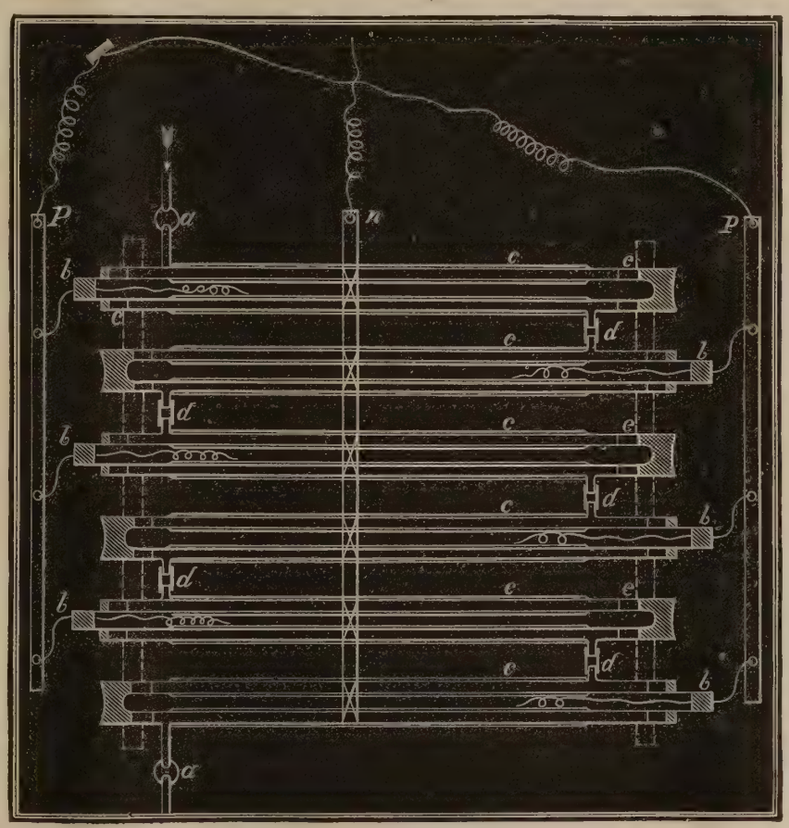


Fig. 2.—Improved Siemens Electrical Ozonizer.

A Novel Lecture Experiment.

Mr. D. S. Holman, the Actuary of the Franklin Institute, has constructed a lantern for the oxy-hydrogen light. It may at a moment's notice be changed into a lantern for showing precipitations, the action of magnets on iron filings, etc., on a screen. It may be readily converted into a projecting microscope, and with equal facility it becomes a megascope for projecting the images of solid objects. In a recent lecture on coins and coinage before the Institute, by Mr. Outerbridge, Jr., of the United States Mint, enlarged images of rare and valuable ancient medals and coins, were, by the aid of this lantern, thrown upon a screen with great sharpness and brilliancy.

But the cupellation of gold and silver, as performed in the assay of precious metals at the mint, was the most striking part of the performance. A little cupel, or crucible, made of calcined bone ash, was held in the focus of the condensing lenses of the lantern by means of a ring of thick copper wire, and the image of the cupel appeared upon the screen greatly enlarged. The cupel was then heated to a white heat by the oxyhydrogen blow-pipe. A weighed sample of gold alloy, containing base metal, was enclosed in an envelope of sheet lead, pressed into the form of a bullet, dropped into the cupel, and immediately melted. As the lead became oxidized, it was gradually absorbed by the cupel. A faint sheet of light was noticed moving over the surface of the melted

metal as the gold became exposed. When the lead was completely absorbed, carrying with it all the base metal in the alloy, the purified gold appeared as a brilliant globule, reflecting the light falling upon its surface like a mirror.

Scientific.

MINUTE WEIGHING AND MEASURING.—When the man of science declares the distance of the earth from the sun to be a certain number of millions of miles, the average unscientific hearer is generally apt to take it for granted that he must be right, for, knowing that by some mysterious means the former is enabled to predict the coming of an eclipse, the advent of a comet, or the occultation of a star, to a fraction of a second, he naturally infers that the command of mathematical methods that suffice to solve these difficult problems, implies the ability to solve the other. He might express surprise, not entirely unmingled with incredulity, when first informed that the methods of science are so marvelously refined that astronomers could promptly detect an alteration in the length of the year —whether a lengthening or a shortening—so trifling as the one-10th of a second; or that it has been demonstrated by actual experimental proof that light travels 192,000 miles in a second. But should any one venture to assert to him that it was possible to measure a period of time less than one-millionth of a second; measure spaces considerably less than the one-hundred-thousandth of an inch; or to weigh quantities as small as the one-billionth of a grain, he would most probably feel that an attempt was being made to impose upon his credulity, and scout the statements as gross exaggerations. And yet the last performances, marvelous as they seem, are simple mechanical operations, which, in spite of their seeming difficulty, are the commonest ways and means employed in physical and chemical investigations.

Without attempting a full detailed description of the very delicate and complex apparatus employed in many of these remarkable methods of precision, we will give, for the sake of illustration, a few of the accomplished results.

Wheatstone, the celebrated English electrician, undertook some years ago to measure the time required for a current of electricity to traverse a comparatively short length of wire. For this purpose he used a small plane circular mirror, rotating 800 times per second about an axis in the plane of the mirror. An observer was so placed that in certain positions of the mirror he could see the image of the luminous point produced by a flash of electricity. If the flash be absolutely instantaneous—that is, of no duration—the image seen will be a mere point of light, no matter how rapidly the mirror may be rotated; but if it has a sensible duration, its image will be drawn into a line. He found, in fact, that by turning the mirror 50 or 60 times per second, the image seen was a mere point; but by giving it greater velocity, it became an arc, the length of which increased with the rapidity of rotation. With a velocity of 800 times per second, he obtained an image of which the length was 24°. The spark then continued during the fractional part of a second required to produce a displacement of the image through an arc of 24°. The laws of reflection teach now, that the image is displaced through a number of degrees twice as great as the angular displacement of the mirror; while the mirror makes one revolution (360°), the image passes through 720°; or in one second through $800 \times 720° = 576{,}000°$; and since it only continues during the time required to pass through 24 of these degrees, its duration is $^{24}/_{576000}$ or $^{1}/_{24000}$ of a second. He now employed this inconceivably small interval of time to measure the velocity of propagation, by an arrangement at once original and ingenious. For this purpose he connected the inner and outer coatings of a Leyden jar, through a long wire broken in three places, so as to give three separate sparks, the distances between each of these breaks being represented by ¼ of a mile; and the breaks were so arranged that they are seen in the rotating mirror in the same straight line. If these three sparks are not absolutely instantaneous, the observer would find the image of the middle one retarded, and it will appear to the right or the left of the upper and lower ones, according to the direction of the mirror's motion. Knowing the time of duration of the sparks, by the method above explained, the time required by the current to traverse the ¼ mile of wire can now be determined by measuring the number of degrees the middle image is retarded to the right or left of the upper and lower images. This was measured by Wheatstone as ½°. The electricity, therefore, passed through this length of wire while the mirror was passing through a ¼°, or while the image was being displaced ½°. But as a displacement of 24° corresponds (as above) to one-24,000ths of a second, the displacement of ½ a degree would correspond to one half of 24, or $48 \times 24{,}000$=one-1,152,000ths of a second. Electricity, therefore, passes through a quarter of a mile, or 1,320 feet, in one-1,152,000ths of a second; or through 288,000 miles in one second.

We might refer, were we not fearful of extending this article to too great length, to the mode by which Nobert has succeeded in ruling scales on glass with a diamond, in which the successive divisions are less than one-100,000th of an inch apart, and which defy the best power of the microscope to resolve them; or to the reflecting pyrometer of Saxton, which readily detects an increase of one-100,000th of an inch in the length of a bar, and which was used in verifying the rods employed in the measurement of the base lines of the larger triangles in the coast survey of the United States.

We will give in conclusion a simple method of highly refined weighing, in which the results are carried to the point of permitting us to say something with positiveness, even of the weight of the chemical abstraction called an atom. For the purpose of the experiment, we will make use of one of the best known of the aniline colors—the so-called aniline red, or fuchsine, which exhibits the wonderful tinctorial qualities of this class of coloring matter to an eminent degree. Upon a delicate balance we weigh with great accuracy as small a quantity as the .0007 of a gramme (about one-10th of a grain) of fuchsine, We dissolve this minute fragment in alcohol, and dilute the solution with water until the volume makes exactly one liter (1,000 cubic centimeters). Even with this enormous dilution, the presence of the coloring matter can be distinctly detected by the unaided eye. Each cubic centimeter of this solution, however, contains .0000007 of a gramme of fuchsine. We remove therefrom, by measurement, 1 cubic centimeter, and of this take one drop, or one-35th of the cubic centimeter. This single drop in a test tube, if viewed against a piece of white paper, still shows a distinct red color. By this simple process of dilution and subdivision, we have rendered it possible for the eye to observe so infinitesimal a quantity of fuchsine as the .00000002 of a gramme (that is, .0007 ÷1000÷35=.00000002), or about three-millionths of a grain. Here now the chemist steps in to aid us, and, just where we have exhausted our mechanical means, enables us to carry the operation still further, by giving us the weight of each of the constituent elements that enter into the constitution of the infinitesimal fraction of fuchsine in our drop of liquid.

The chemist knows precisely the proportions of carbon, hydrogen, nitrogen, and chlorine that are contained in the substance fuchsine, and knows also the relative proportions, by weight, in which these elements always combine with each other. He tells us that he has ascertained the constitution of fuchsine to be $C_{20}H_{19}N_3HCl$—that is to say, the smallest conceivable particle of fuchsine, or each individual ultimate molecule (as the smallest part of a substance is called in which its properties inhere), must contain just so many atoms of carbon, so many of hydrogen, etc., as the above formula expresses. Furthermore, from his knowledge of the elementary properties of fuchsine, and knowing the relative properties by weight in which these elements invariably combine, the chemist can affirm the molecular weight of fuchsine to be 337.5. The relative weight of the hydrogen above, however, as compared with that of the other elements, is 1. It will be apparent, therefore, to one who has followed our reasoning thus far attentively, that since the drop of our solution of fuchsine must contain at least one molecule—for it certainly cannot contain less—the weight of a single hydrogen atom in the drop cannot be greater than the $^{1}/_{337.5}$ of the .00000002 of a gramme, or so inconceivably minute as the .000000-000059 of a gramme, which is approximately the one-1,000,000,000th of a grain.

In an ingenious though unsuccessful effort to apply the spectroscopic method to assaying, Mr. Outerbridge records that he found, when small electrodes of alloys of gold were accurately weighed upon the delicate assay balance, a thousand electrical sparks might be passed between these points, each spark producing a brilliant spectrum of the metal, and yet the total loss in weight was afterwards found to be only the one-1,000th of a grain—that is to say, each spark vaporized (one-1,000÷one-1,000)= one-1,000,000th of a grain of gold.

A POPULAR ASTRONOMICAL ERROR.—One of the boldest speculations in astronomy, and one that has a peculiar fascination for most intelligent students of science, is the hypothesis suggested by the great astronomer, Mädler, that the stellar universe has a motion about a great central sun, the latter being Alcyone, the brightest member of the star group known as the Pleiades. The great reputation of Mädler, caused his announcement at the time to be received with general acceptance; but subsequent investigation of the subject made it apparent that the hypothesis was founded upon such very slender evidence that it has been rejected by astronomers as unproved, though, like most attractive errors, it still holds its place among popular beliefs.

Prof. Proctor, in a late publication, dwells particularly upon this hypothesis of a central sun, and makes it the text of some reflections as to the tenacity with which certain errors retain their hold upon men's minds. From his criticisms of this hypothesis, it would appear that Mädler's idea never received much credence among astronomers, as the evidence that he presented in support of it was exceedingly feeble. It appears that Sir John Herschel pointed out how very unlikely it was that the center of the Milky Way—if such a center there really is—could lie so far away from the mean plane of the Milky Way as the Pleiades. And Proctor, on the same subject, has shown that the only piece of positive evidence advanced by Mädler—namely, the drift of the stars of the constellation Taurus in one direction—was really no evidence at all, for the excellent reason that a similar drift, in other directions, can be recognized in other regions of the starry heavens.

Proctor asserts that no astronomer of repute would now venture to maintain the theory that Alcyone of the Pleiades is the central sun of the stellar system, and that scarcely any one of them would admit the probability of there being any central sun at all. In spite of all this, however, the belief is still widely spread among the general public that Alcyone is the central sun; and, as Proctor remarks, the theory seems to excite far more interest than most of the real discoveries—many of them of vast importance—that have been made during the past half century.

It will be well, therefore, in view of the attitude of the learned world towards the speculation of Mädler, and the pointed declarations made on high authority that the hypothesis never had anything but a species of tolerance among astronomers by reason of the great reputation of its author, and the fact that the only piece of positive evidence in its favor has been completely nullified by similar evidence of a contradictory nature—to consider the idea to be an unfounded speculation.

A NOVEL METHOD OF HEATING RAILWAY CARS is said to be in use on the Paris-Lyons route in France. The

compartment system in the construction of railway cars, which is still very generally maintained on European railways, renders it necessary to adopt special methods of heating them in winter, and generally the simple foot-warmers—flat metallic boxes or cylinders, filled with hot water, and changed from time to time as it cools—are used.

The new method above referred to, consists in using the "acetate of soda" in these foot-warmers. In dissolving in water, this substance absorbs or renders latent a large amount of heat, and when it crystallizes, or solidifies, this absorbed heat is given out again and becomes sensible. The plan is described as follows: The warmers are filled with the solution at a temperature of 212° Fah. This is then allowed to cool, which takes about 12 hours. They are then gently heated in a stove until the crystals, which have separated, are redissolved, when they are ready to be used.

A report of the trial of the new system lately made on the railway in question, states that the train left Paris at 7.15 P. M. and arrived at Lyons at 4.31 A. M. The compartments were each supplied at starting with two warmers, containing the salt as above described. At Lyons, most of the warmers were still so hot that the hand could not be placed upon them. Had the warmers been filled with hot water, the report concludes, it would have been necessary to renew them three or four times.

The different construction of our American railway cars renders such methods of heating as those above described, of no practical interest to us; but the scientific principles involved in the acetate of soda plan are highly interesting, and the experiment may suggest to our readers other applications of this and similar salts, in which the property of yielding up their latent heat during crystallization may be applied to practical uses.

A New Process of Refining Copper, which is reported from Germany, promises very important results. The copper of commerce, which is largely produced by reduction from the ores of that metal, is never entirely free from oxide, which detracts seriously from its toughness; and the process here referred to has for its object the removal of this oxide by employing for the purpose the energetic affinity which phosphorus is known to have for oxygen. The experimental trials first made upon metallic copper with phosphorus in its elementary form, were found to be very satisfactory as to results, but the use of phosphorus in this way was found to be both wasteful and dangerous.

It was subsequently decided to employ a compound containing phosphorus, and for this purpose the phosphide of copper—or phosphor-copper—was selected. The result is said to have supassed all anticipation. As described by Dr. Roessler, the metal taken from the furnace after a very short period had elapsed after the addition of the phosphor-copper, presented quite an altered texture in comparison with the sample taken before its addition. The latter could readily be broken off with blows of the hammer, delivered in one direction; while the former could only be broken after repeated bendings to and fro. In a word, the metal possessed a toughness which was quite astonishing. The fracture was hackly, of salmon-red color, and silky luster, which is characteristic of chemically pure copper, and contrasted strongly with that of the other sample, the fracture of which was that of the refined copper of commerce. The specific gravity of the original metal was 8.731, and that of the metal after treatment 8.906.

An examination of the two metals for oxide showed that the commercial metal contained 0.190 per cent of oxygen, and the metal refined by phosphorus 0.042 per cent. This result, together with the fact of the greatly improved qualities of the refined metal, demonstrated that the phosphorus had very effectually done the work intended; and the procedure bids fair, if these statements may be relied upon, to assume an important position in the metallurgy of copper.

A New Water-Proofing Composition.—A composition, called by its inventor "Neptunite," and which is supposed to be a solution of certain gums, including rubber, has received the warmest praise in the daily papers for its admirable qualities in rendering textile fabrics of all kinds water-repellant. It is affirmed to be applicable to all kinds of textiles—cotton, woolen, silk, velvets, lace, etc., with equal advantage.

A New Metallic Compound.

Abstract of a Paper Read before the Society of Arts of London, by Granville Cole, Ph. D.

The subject of this paper is the discovery of a metallic compound, which I shall prove to you is new, and I shall endeavor further to set forth a few facts, attested by experiments, in respect to its nature. Nearly a year ago, Mr. J. Berger Spence discovered that the sulphides of metals, combined with molten sulphur, formed a liquid. This liquid, on cooling, became a solid homogeneous mass, possessing great tenacity, and having a peculiar dark gray—almost black—color. Nearly every metallic sulphide which is known, combines, as experiments have proved, with an excess of sulphur, and curiously enough, nearly all these combinations have the same properties. The combination consists of an ore of iron pyrites containing both lead and zinc sulphides. Examining the metal from a chemical point of view, I may state briefly, that it is a chemical compound belonging to that class known as thiates, or sulphur sulphides. Dr. Hodgkinson, chemical demonstrator at the Science Schools, South Kensington, has kindly sent me the following facts. I cannot do better than quote his letter on the subject:

"It appears to be the easiest thing in the world to obtain a homogeneous casting with it. Specific gravities of portion sent gave 3 3743 to 3.7036 (reduced to 0° C.) When finely powdered, it is acted upon slowly by concentrated HCl and NO_3 HO in the cold; in large lumps, little or no action takes place. As yet I have not been able to determine the expansion equivalent accurately; it would appear, however, to be small. The fracture is not conchoidal, as might perhaps have been expected, but somewhat like that of cast iron. I have not had time to try many 'utilization experiments' on the substance, but have no doubt it would be exceedingly useful in the laboratory, even, for instance, for making the air-tight connections between glass tubes, by means of caoutchouc, and a water or mercury jacket, where rigidity is no disadvantage; the fusing point is so convenient (about 340°), that it may be run into the outer tube on to the caoutchouc, which it grips, on cooling, like a vice, and makes perfectly tight. I do not know what you may call the material, but should think, as it seems to be more than a mere mixture, 'ferric thiate' would not be a bad or inappropriate name."

I propose to illustrate, by experiments such as are possible at a lecture, some of the properties of the metal. I will begin by giving a short summary of its peculiarities, and its advantages over those of other metals or metallic compounds.

1. It has a comparatively low melting point—namely, 320° Fah., or rather more than 100° above the temperature of boiling water. Here, then, we have in its favor the small amount of fuel needful to supply the necessary heat for reducing the metal to a condition for use.

2. It expands on cooling, a property not shared by the majority of other metals or metallic compounds. I believe that type metal and bismuth are two exceptions. Later on, I will show that for an operation like the joining of gas and water pipes, this expanding property is one of great importance.

3. It claims to resist atmospheric or climatic influences, as compared with bronze or marble. I noticed lately how the statues in bronze, on the Holborn Viaduct, had been affected by our London fogs. And I have evidence to produce in the direction of showing the imperviousness of the metal to such degrading influences.

4. As compared with other metals or metallic compounds, its resistance to acids (used commercially), to alkalies, and to water, is certainly superior.

5. A smooth surface of this metal or metallic compound, now known commercially as Spence's metal, takes a very high polish. I will illustrate this by casting some of this molten metal on to a surface of glass.

It may, perhaps, be interesting to learn the manner in which Mr. Spence first thought of utilizing this metal for works of art. In order to obtain a perfectly smooth surface, he had been running molten metal on to a piece of glass, as I have just done. But before doing so, he had chanced to touch the glass, and had left the marks of the pores of the skin of his fingers upon it. On removing the metal, these marks were found to be reproduced, and so indelibly that they did not disappear on polishing the surface metal. This led Mr. Spence to try to cast the metal in a mold; and although at present no artistic work of high order has yet been reproduced, I venture to think that enough has been done to justify the expectation that, in a short time, standard works of both ancient and modern art may be successfully reproduced. Various colors, such as the green patina of bronze, the dark blue hue of steel, and the appearance of silver and gold, have already been obtained. Experiments are now in progress, which give promise of enabling those who adopt this metallic compound for such uses, to reproduce metallic works in their original colors.

I have a casting that was made from a nickel-plate engraving; every line, however minute, has been reproduced in Spence's metal. Experiments are now being carried on to test the adaptability of the metal for printing and stereotyping purposes, but they are not complete, so I refrain from giving any facts about them. Besides this, experimental castings have been made of various medallions and busts, notably, a large bust of her Majesty the Queen. The metal in this case has not subsequently been treated in any way beyond being polished with a cloth. The metal can be cast into almost any material used for molds.

Mr. Spence has succeeded in obtaining casts from metal molds, plaster molds, and even from gelatine molds. These last are probably the first metallic castings produced from gelatine molds. Spence's metal being almost a non-conductor of heat, cools so rapidly in the gelatine mold that it yields a perfect impression before the form of the mold is destroyed; and if the gelatine be allowed to remain on the metal till cold, it remodels itself ready for the next casting. It is, therefore, hoped that an additional process has been secured by which the most undercut objects may be reproduced successfully and easily. The advantages which Spence's metal possesses over other materials used for artistic productions, may be summarized under three heads, namely, (1) cheapness, (2) facility of working, and (3) resistance to climatic influences.

Cheapness.—As compared with lead, which is one of the cheapest of metals, it is one-third the weight, and, whereas the average cost of lead for the last ten years has been nearly $90 a ton, Spence's metal only costs $75. A ton of the latter metal being three times the amount in bulk of that of a ton of lead, it is available for three times the amount of work. It may, therefore, be considered to be nearly a quarter of the price of lead, and, consequently, very considerably less than that of bronze.

Facility of Working.—Its melting point being very low, it can be quite easily prepared for pouring into a mold, and its property of expanding, when cooling, causes it to take such a perfect impression, that the cast requires very little chasing after. In respect of a gelatine mold, which can cover a considerable surface of work without joints, such as has to be made in plaster-piece molding, the metal cast obtained from such a mold would require no chasing whatever.

Resistance to the Atmosphere.—With regard to its resistance to climatic influences, experiments have been conducted in this direction with complete success. A polished surface of the metal has been exposed for six months in all weathers, without showing the least change. (*Conclusion next Month.*)

Rotary Steam Engines.

We illustrate, in the accompanying plate from "Knight's American Mechanical Dictionary," a series of views of rotary engines, which will be useful for reference to many of our mechanical readers who have not the advantages of an encyclopedia for consultation. We give the plate and accompanying explanations by special request.

A rotary engine is one in which the piston rotates in the cylinder, or the cylinder upon the piston. The varieties of engines of this class are numerous, comprising engines with one, two, three and four pistons on single axes; pistons working in pairs on several axes; wheels driven by steam injected against them, or working by reaction, emitting steam longitudinally. Engines of this class were first suggested by inventors and introduced about the beginning of the present century.

The annexed plate shows quite a variety of forms of this class of machines, which will be understood from the following description: *a* has a single piston keyed to the hub, and rotating in an annular chamber, which has the function of a cylinder. In the middle, on the right, is the abutment, which slides radially to allow the piston to pass. Above and below the abutment respectively are the induction and eduction ports.

b, Has a single piston, which passes a crescent shaped rocking abutment situated between the induction and eduction ports.

c The piston revolves on a hub concentric with the cylinder, and the annular steam space between the hub and cylinder side is traversed on each side alternately by sliding abutments, connected together and operated by a segmental cam on the piston shaft, which impinges against antifriction rollers of the frame.

d, The steam issues from the piston at * and is educted at ×, passages being provided through the tubular shaft. The abutments swing out of the way for the passage of the piston, being actuated by connecting rods and levers operated by a cam on the main shaft.

e, The piston wheel is arranged eccentrically within the cylinder, and has two buckets, which are expanded radially by springs, and withdrawn to pass the abutment by contact with the cylinder. Packing segments on the piston wheel and the edges of the buckets confine the steam.

f, Has an elliptical piston, the working faces of which are expansible by screws to pack it against the inside of the annular chamber in which it revolves. It has a rocking abutment, which oscillates in a chamber.

g, Has two pistons, with vibrating abutments, which retract into recesses to allow the pistons to pass.

h, The pistons are situated upon the extremities of the hollow arms; the steam ports in the hub of the main shaft serve as induction passages for the steam, the eduction ports being located upon the periphery of the enclosing case of the engine. The steam is admitted to a chamber in the shaft through a pipe which revolves therewith.

j, Has three pistons, which have a certain freedom of motion in seats in the inner cylinder, which rotates in an eccentric drum.

k, Has three pistons on a wheel keyed to the main shaft. Inclines on the advancing faces of the piston push back the swinging abutments, which then close the eduction. The induction ports are above and below.

l, Has three pistons, two valve abutments, and two induction and eduction ports.

m, Has three pistons on one shaft, set at angles of 120°. Steam admitted at one side of the casing, and departing at the other, presses against a flexible band, which drives the pistons before it.

n, The eccentric hub revolves in the annular cylinder, and has pistons arranged on yokes, traversing at right angles to each other, and provided at their ends with spring packing plates, which accommodate themselves to the interior surface of the cylinder. The induction openings are also covered with flexible plates, which accommodate themselves to the surface of the hub and permit the passage of the piston. The engine runs in either direction, and exhausts at the bottom.

o, Has also diametric pistons, which are equal to the diameter of the casing, and slip to and fro in slots in the eccentric hub.

p, Has four distinct pistons, which slip in and out in radial slots in the circumference of the eccentric hub. Steam is admitted and educted by flexible pipes. The abutment, as in the last two mentioned, is formed by the contact of the hub with the inside of the cylinder.

q, Is the Scheutz (a Swedish) engine. Its hub and cylinder are concentric, and the abutments are formed by double inclines, which force in the pistons as they come in contact therewith. Steam is introduced and discharged at ports leading through the inclines on the respective sides of the abutments.

r r', Has two pairs of pistons, each attached to a core, which occupies but half the length of the cylinder in the direction of its axis. Each pair of pistons is thus attached to its own core for only half the piston length, while the other half projects over the core belonging to the other pair. Neither pair of pistons can, therefore, pass the other, though they may come into contact.

s s' s'', Are three views of an American engine (Behren's). The views show three positions of the pistons, which work in apposition. It has two cylinders, the spaces of which overlap each other, and in the center of each is a solid cylindrical core. Each piston is firmly attached to an axis, and is part of a solid ring fitting to the core and to the interior of the cylinder. The axes are externally connected to gear wheels, to insure simultaneous and equal action.

t, Is the Pillner & Hill engine (English), with two cylindrical overlapping chambers, and two systems of rotary pistons, which may be compared to cog-wheels. These wheels, by the close contact of their cogs, prevent the passage of steam between them, and they are adapted steam-tight to the interior of their cylinders by metallic packing in the tips of their teeth; *u* is a somewhat similar form; and in *v* a jet of steam is forced against the vanes of a wheel as they are presented in turn in a steam-tight case.

The above by no means includes all the multifarious forms of rotary engines, since their name is legion; but the description will fairly illustrate the more pronounced types of this class of machines.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$60 00	*a*	— —
Pine, good	50 00	*a*	55 00
Pine, shipping box	18 00	*a*	22 00
Pine, common box	17 00	*a*	18 00
Pine, common box, ⅝	15 00	*a*	16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	40	*a*	— —
Pine, tally plank, 1¼, 2d quality	35	*a*	38
Pine, tally plank, 1¼, culls	28	*a*	30
Pine, tally boards, dressed, good	28	*a*	30
Pine, tally boards, dressed, common	22	*a*	25
Pine, tally boards, culls, dressed	22	*a*	25
Pine, strip boards, merchantable	16	*a*	18
Pine, strip boards, clear	22	*a*	25
Pine, strip plank, dressed, clear	33	*a*	35
Spruce boards, dressed	20	*a*	22
Spruce plank, 1¼-inch, dressed	25	*a*	28
Spruce plank, 2-inch,	40	*a*	— —
Spruce wall strips	13	*a*	— 15
Spruce timber, per M	18 00	*a*	22 00
Hemlock boards, per M	15 00	*a*	16 00
Hemlock joist, 2½x4, each	15	*a*	— 16
Hemlock joist, 3x4	16	*a*	— 18
Hemlock joist, 4x6	40	*a*	— 44
Ash, good, per M	40 00	*a*	45 00
Oak	50 00	*a*	85 00
Maple culls	25 00	*a*	30 00
Maple good	45 00	*a*	75 00
Chestnut	45 00	*a*	50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00	*a*	40 00
Black walnut, good to choice	85 00	*a*	100 00
Black walnut, ⅝-inch	75 00	*a*	85 00
Black walnut, selected and seasoned	110 00	*a*	150 00
Black walnut counters, per ft	12½	*a*	20
Cherry, wide, per M	85 00	*a*	100 00
Cherry, ordinary	60 00	*a*	80 00
White wood, inch	45 00	*a*	55 00
White wood, ⅝-inch	30 00	*a*	45 00
White wood, ⅝ panels	35 00	*a*	45 00
Shingles, extra sawed pine, 18-inch	4 00	*a*	5 00
Shingles, clear sawed pine, 16-inch	3 75	*a*	4 00
Shingles, cypress, 24x6	18 00	*a*	21 00
Shingles, cypress, 20x6	10 00	*a*	12 00
Lath, Cargo rate	1 50	*a*	1 60
Yellow dressed pine flooring	25 00	*a*	30 00
Yellow pine girders	30 00	*a*	40 00
Locust posts, 8 feet, per inch	18	*a*	20
Locust posts, 10 feet	24	*a*	25
Locust posts, 12 feet	29	*a*	34
Chestnut posts, per ft	3	*a*	3½
Basswood per M	25 00	*a*	30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.		Afloat.
Pale, per M.	5 00	*a*	5 25
Up Rivers	6 00	*a*	6 50
Jersey	— —	*a*	— —
Long Island	— —	*a*	— —
Haverstraw Bay	7 25	*a*	7 50
" " choice	7 75	*a*	8 00
Favorite Brands	— —	*a*	— —
Hollow Fire-Clay Brick	9 00	*a*	9 25

FRONTS.

Croton—Brown, per M.	10 00	*a*	11 00
" Dark	11 00	*a*	12 00
" Red	12 00	*a*	13 00
Philadelphia	— —	*a*	— —
Trenton	21 00	*a*	22 00
Baltimore	38 00	*a*	— —
Clark's Ottawa White	25 00	*a*	— —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	23 00	*a*	24 00
" Glengarnock	21 00	*a*	22 00
" Eglinton	20 00	*a*	21 00
" American, No. 1	26 00	*a*	27 00
" American, No. 2	24 00	*a*	26 00
" American, forge	22 00	*a*	24 00

	Store prices.		Cash.
Bar, Swedes, ordinary sizes	— 6	*a*	— 6¼
Bar, Swedes, nail-rod	— 6½	*a*	— —

LEAD—PER 100 POUNDS.

*German	— —	*a*	— —
*English, common	— —	*a*	— —
*Spanish	— —	*a*	— —
*Foreign, refined	— —	*a*	— —
*Bar	7 50	*a*	— —
*Sheet	9 00	*a*	— —
*Pipe	— —	*a*	— —
*Domestic	5 75	*a*	— —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 70	*a*	— —
8d and 9d, common	3 95	*a*	— —
6d and 7d, common	4 20	*a*	— —
4d and 5d, common	4 45	*a*	— —
3d and 4d, light	5 20	*a*	— —
3d, fine	5 95	*a*	— —
2d, fine	5 95	*a*	— —
Cut spikes, all sizes	4 95	*a*	— —
Clinch nails, 1½ to 1¾ inch	5 95	*a*	6 20
do. 2 to 2¼ inch	5 70	*a*	— —
do. 2½ to 2¾ inch	5 45	*a*	— —
do. 3 inch and longer	5 20	*a*	— —

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	9 50	*a*	10 00
*I. C. coke, 10x14	7 50	*a*	8 75
*I. X. charcoal, 10x14	11 50	*a*	12 00
*I. C. charcoal, 14x20	9 50	*a*	10 00
*I. X. charcoal, 14x20	11 50	*a*	12 00
*I. C. coke, 14x20	7 50	*a*	8 75
*I. C. coke, terne, 14x20	7 50	*a*	8 25
*I. C. charcoal, terne, 14x20	8 50	*a*	9 00

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 8¼	*a*	— 8½
Sheet, (open)	— 9	*a*	— 9½

SOLDERS.

No. 1	— 13½	*a*	— 14
No. 2	— 12½	*a*	— 13

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95	*a*	1 00
Berlin Freestone, in rough	— 75	*a*	1 00
Berea Freestone, in rough	— 75	*a*	1 00
Brown-Stone, Portland, Conn	1 30	*a*	1 35
Brown Stone, Belleville, N. J	1 00	*a*	1 35
Granite, rough	— 60	*a*	1 25
Canaan Marble	1 25	*a*	1 50
Dorchester, N.B., Stone, rough, per foot	— —	*a*	1 00

PAINTS.

*Carmine, American, per lb. gold	7 00	*a*	7 25
Chalk, per 100 lbs	— 35	*a*	— —
China Clay, per ton gold	18 00	*a*	20 00
Chrome yellow, dry, per pound	— 12½	*a*	— 28
Lead, red American, per pound	— 8	*a*	— 9
Lead, white American, pure, in oil	— 9	*a*	— 9½
Lead, white American, pure, dry	— 8¼	*a*	— 8¾
Lead, white English, pure, in oil gold	— 9½	*a*	— 10½
Litharge	— 7½	*a*	— 8
*Ochre, Fr., dry, per 100 lbs	1 50	*a*	— —
Ochre, ground, in oil, per lb	— 6	*a*	— 15
Ochre, Vermont, per 100 lbs	— 75	*a*	1 00
*Orange Mineral, English gold	— 9½	*a*	— 10
Paris White, American	— 1½	*a*	— 1¾
Paris White, English, prime	— 2	*a*	— 2¼
Paris Green	— 15	*a*	— 28
Plumbago paint, patent, per lb	— —	*a*	— 25
Putty, per lb	— 2½	*a*	— 3
Spanish Brown, dry, per lb	— 1⅜	*a*	— 1¼
Spanish Brown, ground in oil, per lb	— 8	*a*	— 9
Venetian red, per cwt	1 75	*a*	2 00
*Vermilion, Chinese, per lb	— 85	*a*	— 90
*Vermilion, Trieste	— 70	*a*	— 75
*Vermilion, quicksilver, bags gold	— 60	*a*	— 62½
Vermilion, American, common	— 15	*a*	— 18
Whiting, per 100 lbs	— 60	*a*	— 80
Zinc, white American, dry, No. 1	— 5	*a*	— 7½
Zinc, white American, No. 1, in oil	— 8	*a*	— 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¼	*a*	— 9
Zinc, white French, in oil gold	— 10	*a*	— 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50	*a*	4 00
Coach Body	2 35	*a*	3 50
do do	1 80	*a*	2 00
Furniture	1 25	*a*	2 50
Black Asphaltum	1 00	*a*	1 50
Brown Japan	1 00	*a*	1 20
Liquid Paint Dryer	1 35	*a*	1 75
Harness, (black)	3 00	*a*	4 50
Shellac, Spirits	3 00	*a*	3 50

CEMENT—PER BARREL.

Portland (imported)	2 85	*a*	3 25
Portland (American)	2 65	*a*	3 00
Portland (Spanish)	2 50	*a*	2 75
Portland (Lafarge)	3 20	*a*	3 40
Portland (German, Bonner)	2 85	*a*	3 25
Lime of Teil	2 20	*a*	2 30
Lime of Teil, per ton	15 00	*a*	18 00
Roman	2 75	*a*	3 25
Keene's & Martin's, coarse	6 00	*a*	6 50
" fine	10 50	*a*	— —
Rosendale	1 10	*a*	— —

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb. — 1¼ *a* — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16	*a*	— 18
Goat, " "	— 21	*a*	— 25

SLATE.

Purple roofing slate, per square	$6 00	*a*	6 50
Green slate	7 00	*a*	7 50
Red slate	10 50	*a*	11 00
Black slate, Pennsylvania, (at Jersey City)	3 50	*a*	4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20	*a*	— 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50	*a*	4 00
Nova Scotia, blue	3 50	*a*	3 75
Calcined, Eastern and city, per bbl	— —	*a*	— —
Calcined, city casting	— —	*a*	— —
Calcined, city superfine	— —	*a*	— —

LIME—PER BARREL.

State, common	— 90	*a*	— —
" finishing	1 15	*a*	— —
Rockland, common, cargo rate	1 00	*a*	— —
" finishing	1 15	*a*	— —
Ground	1 00	*a*	— —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 20	*a*	— 35
St. Domingo, crotches, fine	— 25	*a*	— 50
St. Domingo, logs, small	— 5	*a*	— 8
St. Domingo, logs, large	— 20	*a*	— 30
Frontera, Mexican, large	— 11½	*a*	— 16
Frontera, Mexican, small	— 8	*a*	— 10
Other Mexican	— 8	*a*	— 14
Honduras	— 10	*a*	— 15

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½	*a*	— 6
Rio Janeiro, good to fine	— 5	*a*	— 8
Bahia, ordinary to good	— 2	*a*	— 6½
Bahia, good to fine	— 4½	*a*	— 8
Honduras, per ton	10 00	*a*	20 00
Satin Wood, per foot	— 15	*a*	— 60
Tulipwood, per lb	— 6	*a*	— 12½
Lignumvitæ, small, per ton	25 00	*a*	65 00
Lignumvitæ, large	25 00	*a*	50 00

CEDAR.

Cuba, per superficial foot	— 10	*a*	— 12½
Mexican, small	— 8	*a*	— 10
Mexican, large	— 10	*a*	— 14
Florida	— 30	*a*	1 50

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¼ inch.	$ 84	—
2.6 x 6.6	1¼	1 18	—
2.6 x 6.8	1¼	1 24	—
2.8 x 6.8	1¼	1 30	—

DOORS, MOLDED.

Size.	1¼ inches.	1½ inches.	1¾ inches.
2.0 x 6.0	$1 54	—	—
2.6 x 6.6	1 90	2 41	—
2.6 x 6.8	1 96	2 43	—
2.6 x 6.10	1 98	2 51	—
2.6 x 7.0	2 02	2 61	—
2.8 x 6.8	2 02	2 61	3 20
2.8 x 7.0	2 11	2 71	3 36
2.10 x 6.10	2 23	2 82	3 55
3.0 x 7.0	2 33	3 06	3 75

OUTSIDE BLINDS.

Up to 2.10 wide, per lineal foot	25	*a*	—
Up to 3.1 wide	27	*a*	—
Up to 3.4 wide	30	*a*	—

INSIDE BLINDS.

Per lineal foot, 4 folds, pine	56	*a*	— —
Per lineal foot, 4 folds, ash or chestnut	— 90	*a*	— —
Per lineal foot, 4 folds, cherry or butternut	1 07	*a*	— —
Per lineal foot, 4 folds, black walnut	1 30	*a*	— —

WINDOW FRAMES.

Up to 3.4 x 7.2, put together	2 30	*a*	— —

REVIEW OF THE MARKETS.—In the lumber market the past month an outlet has been afforded for pretty much all the desirable stock offering, and the changes in values have been few. When there has been any variation, however, it has been rather on the downward incline, and the advantage has not been so universally in seller's favor as during the previous month.

In the brick market prices generally have been lower. Receivers say that there has not been a large amount of stock afloat, but still the supply has exceeded the demand, and a constant shading has been necessary in order to secure customers. The tendency at the present writing is still downward.

In the lime market the advantage has been with the seller, and trade has shown a generally steady tone. Supplies have not been very large, and apparently exhausted without much difficulty, with room for more, and some occasional selling of stock ahead of arrivals.

In the lath market not much of interest has developed since our last. Supplies have been small and buyers indifferent.

In the hardware market dealers have seemed to have given up all attempts to convey a cheerful tone to their reports of the market, and a great many indeed have not hesitated to characterize matters as hopelessly demoralized. The distribution of supplies has been confined entirely to small jobbing parcels, and beyond this limit buyers seemed fully determined not to go.

In the metal markets Scotch pig has met with sad reverses since our last writing, owing to the heavy pressure to realize. Holders, however, have since recovered in a measure from this panic, and there now seems to be a little more tone with even a fair sort of demand. American pig has also undergone a considerable break, and has, it is thought, at last reached "hard pan." Supplies are in strong hands, the production under better control, and while no positive reaction on cost is expected by sellers, they seem confident that a further decline is out of question. Manufactured iron has scarcely reached a settled basis—indeed, of all articles on the list of iron, it is probably the most uncertain as to position and value. Domestic pig lead has been quite dull, and few movements made public except in a jobbing way. Tin in pig has been quite unsettled, with only a light trade, and the feeling generally nominal. Tin plates have been in better demand, and have been, as a rule, steadier on all the leading grades of stock. Zinc has been in moderate demand, with prices a little weak.

In the paint market the local consumption has been good, and prices fair.

COAL IN CHINA.—The immense coal fields of the Chinese Empire are slowly being developed, the superstitions of this strange people being overcome. In a district near Tchang, on the Upper Yang-tse-Kiang, a coal field extending over 75 square miles has been tapped. At Wo-tze-kow ten beds of coal have been discovered; one of them, lying only 100 feet below the surface, is being worked, and at least 1,200,000 tons of anthracite have been exposed.

Improvement in Canal Boat Propulsion.

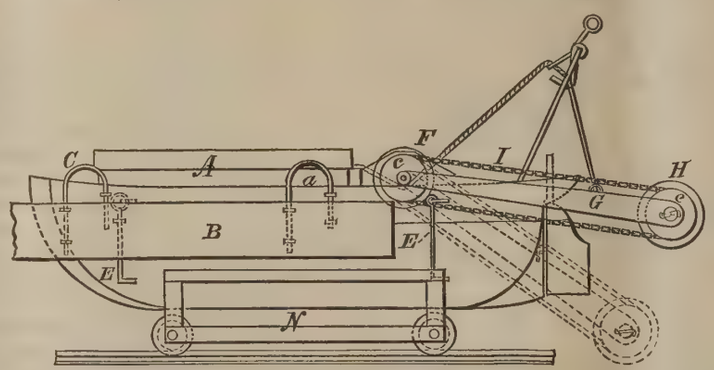
We describe and illustrate herewith a novel invention designed to obviate the standing objection to the introduction of steam power as a means of propelling canal boats, *i. e.* the washing and undermining of the banks by the wash or swell from the bows and sides of the boat. Besides the feature of novelty, the invention embodies some ideas that are decidedly meritorious which will appear in the course of this description. The inventor has caught the ingenious notion of saving the banks of the canal from the effects of the wash of the boat, by providing the boat, so to speak, with its own banks; these consist of lateral plates extending forward so as to project beyond the bow on each side of the boat, held at a suitable distance from its sides. These plates are buried in the water to a considerable depth to enable them to intercept the swell, and deflect its course along the sides of the vessel to its stern.

These guard plates are secured to, and suspended from the sides of the boat by means of davits, by which they may be swung in or out from its sides as may be necessary. When in service the plates are held out from the sides in proper position by means of stay-hooks, which may be detached when the plates are to be taken alongside. In addition to this the inventor has provided a method of propulsion that is quite as novel. This consists of a paddle wheel, suspended by means of vibrating arms over the stern of the boat, and which may be raised out of the water or lowered to the bottom of the canal by means of a crane provided for the purpose; the construction of the wheel adapting it to propel the boat either by working in the water or against the bottom of the water-way.

These are the essential features of the invention, which will be better understood by the following references to the annexed cut, which gives a side view of the boat and its several attachments: A represents the boat; B, the lateral guard plates suspended from it by means of the davits C. As before stated, when in position, the lower portions of the guard-plates are immersed to a considerable depth in the water, and their front ends extend out beyond the bow of the boat. This device provides a space between the lateral plates and the sides of the boat, so that as the latter forces its way through the water, the wave or swell formed by the sheer of the bow, strikes against the plates, and instead of washing the banks, is, by the plates, arrested and deflected along the sides of the vessel out at its stern in the length of the water course. The detachable stay-hooks E maintain the guard-plates at their proper position from the sides of the boat, so long as they are in use. On going alongside of a wharf, the stay-hooks are detached, thus permitting the plates to be swung by the davits C, alongside the boat.

The details of the propelling mechanism will be understood by the following references to the cut.

F, represents a transverse shaft arranged in suitable bearings near the stern of the boat, and provided at each end with a chain-pulley, *c*; and at its center with a pulley (not shown), or equivalent device, through which the shaft may be set in rotation from any suitable motor provided for the purpose. To the ends of shaft F are journaled, wooden beams, G, which afford bearings at the lower ends for the transverse paddle wheel, H. This last, in turn, has at each end a chain-pulley, *e*, connected by an endless chain-belt, I, with the pulleys, *c*, upon the shaft, F. The rotation of the shaft is thus imparted to the paddle wheel. The action of the device for hoisting and lowering the frame and its attached paddle wheel is too manifest to demand detailed description. By means of the rope and the metallic bail the propeller may be lowered in shoal water until it bears against the bottom (when its rotation will propel the boat) or raised in entering a lock, or in deep water, it may be raised until it is only half submerged, when its rotation will advance or back the boat as may be desired. The wheel not shown in detail in the cut, is of peculiar construction to adapt it to its modified service; it consists, briefly, of two pairs of spaced end-disks at each end of a shaft, which may be partially or wholly boarded-in. The paddle boxes are arranged radially around the shaft, between the inner disks; and the outer edges of the boxes are made to project slightly beyond the circumference of the disks to give them a better hold on the bottom of the canal. The boarding-in of the two spaced end-disks prevents the wheel from sinking too deeply into the bottom. In making portages, the inventor designs to cradle the boat upon a carriage, N, which is run up an inclined way by the propulsion of the wheel, H. From the foregoing account, our readers will have perceived that the invention possesses a number of novel and ingenious features, which may prove in practice to be advantageous. The patentee is John H. Hetzler, No. 152 Pine street, Baltimore, Md., to whom any communications for the purchase of the patent right, or of canal rights, may be sent, and at whose address can be seen a working model of the invention.



Improved Method of Canal-Boat Propulsion.

LITHOGRAPHIC STONE, said to be quite as good for lithographic uses as the standard stones so long imported into this country from Germany, is reported to have been found in Canada. The quarries are extensive and the stone is said to have been thoroughly tested with satisfactory results by practical lithographers. The quarries are at Marmora. A deposit of lithographic stone has been found in the State of Kentucky, of which considerable expectations were at one time entertained, but we have heard nothing further concerning it.

Paints.

Referring to an article on this subject which appeared in our issue for April, concerning which several inquiries have reached the office, we are enabled to add herewith some additional facts of interest concerning the Asbestos paints which were then specially referred to.

We learn that the Oriental Hotel, the largest of all the immense hotels at Manhattan Beach; the Pequot House, New London, Conn.; and the Old Orchard Beach Hotel, Maine, are now being painted with H. W. Johns asbestos liquid paints, which are rapidly superseding all others for large and elegant structures, and for the better classes of dwellings everywhere, for the following reasons:

These paints are specially prepared for exposed wood-work and iron structures, for which uses they are at once economical and durable. For inside work and general uses, they are affirmed also, to be no less valuable. Respecting the composition of the "Asbestos Liquid Paints," we are informed in respect to their manufacture that none but the purest linseed oil is employed in their production, and that they contain neither water, alkalies, benzine or other adulterants and dilutants, which, as is generally known, enter in no small degree into the composition of many of the so-called "chemical" and other proprietary paints.

The manner of preparing the Asbestos paints is described as follows: The entire body of the paints is first ground in oil, then mixed to the proper consistency, and afterwards ground through fine mills, by which procedure the thorough and intimate mixture of the oils and pigments is insured.

In respect to the general qualities of these paints we add some points of interest, which are claimed to characterize them. They have been thoroughly tested in all parts of the world and have been found to withstand the severest climatic changes, salt water atmosphere, and other trying exposures, where the best paints of other kinds have failed, and it is affirmed, with the most satisfactory results. Furthermore, in respect to richness and permanency of color, covering properties, beauty of finish, durability and other characteristics of a perfect protective covering for structural work, these paints are claimed to be equal to the best. They possess an elastic quality, which prevents them from cracking or scaling, and are prepared ready for the brush. They may, of course, be thinned down the same as any oil paint, if desired. These paints, finally, are prepared specially for various applications for which they are designed; so, for example, the manufacturers produce special qualities for inside work; roof paints specially prepared, of a number of colors, for preserving tin and other roofs; fire-proof paints, specially prepared in white and light tints, for inside work upon the wood-work of factories, mills and generally for the protection of wood-work that is liable to the danger of catching fire from any cause.

These paints are prepared in any shades that may be required.

Additional information will be furnished respecting these products, by addressing the manufacturers, the H. W. Johns M'f'g Co., 87 Maiden Lane, New York City.

Ancient Iron Manufacture.

Mr. A. L. Holley thus describes the composition and manufacture of a piece of ancient Egyptian iron taken from the base of the obelisk which is to be brought to America:

"If we had not known from the general history of the iron manufacture that the specimen must have been made by the Catalan process, the analysis would have so indicated. The notable facts in the analysis are: About half a per cent of carbon, giving the hardness of ordinary rail steel; very low silicon and phosphorus, due to the method of manufacture; and a remarkably large amount of calcium, indicating the plentiful use of lime as a flux in the process. The small amount of slag, (for a Catalan product), as well as the fine fracture, indicate frequent reworking. The Catalan process is simply subjecting to a high red heat pulverized iron ore mixed with charcoal—enough to combine with its oxygen. The product is a pasty mass of iron, which is substantially pure chemically, excepting the little carbon it has got out of the fuel, but which is mechanically mixed with silica, phosphate of lime, alumina, and other impurities the ore had. By repeatedly heating the mass to a plastic condition, and hammering it, this dirt is pretty well expelled, and the product, although costly, is excellent wrought iron. This process is still in use where ore and charcoal are very cheap, but the modern soft steels have almost displaced it as a material for boiler plate and other fine products. Yet, curiously enough, as Catalan iron is supplanted by steel, the Catalan process is coming into still greater use to furnish material for open-hearth steel. The pasty mass above described quickly melts in the cast-iron bath of the open-hearth furnace, and mechanical impurities float off as slag. Dr. Siemens' modern improvement of the Catalan process—performing it in a steam-rotated regenerative gas furnace, and on a very large scale—produces so cheaply that it is likely to furnish most of the material for fine open-hearth steel. Thus, the prehistoric method, facilitated by modern engineering, is coming again to the front."

Home Department.

The Growler.

From time immemorial, the species of humanity known by the name of "growlers" has existed, and as long as the earth continues they are likely to exist. There are worse characters than the mere ordinary "natural growler," but none smaller or more annoying to sensitive people. They are the little torments which worry life and make thousands of others unhappy. A small splinter inserted in the flesh is not as painful as a broken limb or a severe toothache; but it is a source of perpetual annoyance, and if allowed to remain, will produce festering and perhaps aggravated sores. "Growlers" are the human splinters in the flesh of business, social and family life, and many are the bad sores caused by their presence in home circles and business connections. I have tried to call to mind some large-hearted, liberal-minded persons addicted to this weakness, but fail to recollect any. Men and women of better impulses and good judgment do not indulge in the offensive habit. It requires a crooked, dwarfed, soured mind to be "ever on the growl." Such people do a vast amount of harm—perhaps innocently on their part—by souring the tempers of others, and destroying peace of mind and comfort to themselves. In some it is an inherent defect, resulting from some natural physical cause—a lack of full development in some of the organs or faculties—while in other cases the disappointments and adversities of life, and contact with unscrupulous men, may sour and contaminate the mind and judgment to the extent of producing a complaining, "growling" disposition. The peculiar feature of the case is, that those addicted to the practice are oblivious to the fact, and the meanest growler that lives will swear that he or she never growls. If one of this sorts sees another prospering more than himself, he begins to complain and growl because he is less successful than his neighbor—failing to realize that his lack of success arises more from the errors in himself than superiority in the other. He might have won that which his neighbor has secured, but for his own peculiarities, which drive people from him, and then he growls because they go. To secure the appreciation of others, the exercise of the spirit of appreciation is a necessity on our part. The greater portion of the joys and discomforts of life are reflected from our own acts. Kindness to others generally returns to ourselves with interest, and the pathway of time is lighted by the shining back upon ourselves of the golden rays of good acts and pleasant words to others.

A Health-Saving Device for Women.—The London *Lancet* calls attention to the danger incurred in the case of young girls by prolonged stooping over work and crossing of legs. Dr. Malherbe, with the view of obviating these evils, has invented a plan which consists of fixing to the edge of an ordinary table a sort of cushion, on which the work can be easily fastened or spread out, as on the knee. A framework of the simplest description admits of the raising or lowering of this cushion, so that the work may be done sitting or standing, but in either case the vertebral column is maintained perfectly straight, while the facility of change of position greatly lessens fatigue. To test the invention, Dr. Malherbe introduced it at the Communal School of Nantes, and with good effect on two pupils, who had a tendency to malformation.

Cooking Sugar with Acid Fruit.—The President of the Michigan State Board of Health lately called attention to the bad practice among cooks of putting sugar into a mass of acid fruit and cooking the same. As by this process the fruit acid converts a large percentage of the cane sugar into grape sugar of much inferior sweetening properties, the result is that the mass is becoming sourer instead of sweeter, and more sugar must be added from time to time. The proper method is to cook the fruit, and then add the required amount of sugar, when much less will be consumed.

An Automatic Ventilator.

There is probably no question concerning which discussion will elicit greater differences of opinion than that of the proper method of heating and ventilating

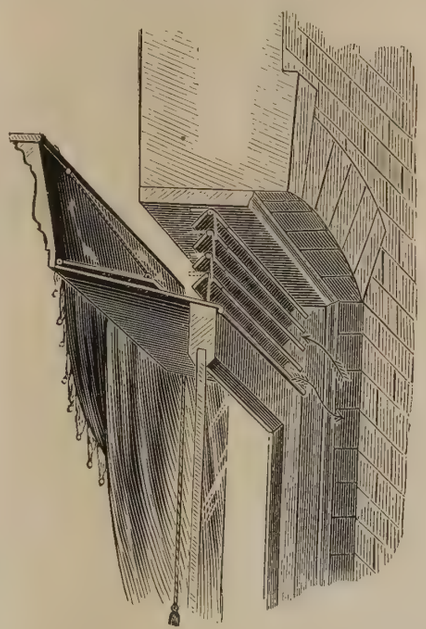


Fig. 1.

buildings and dwelling apartments. These differences do not in the least bear upon the principles involved in the circulation of atmospheric currents, as these are well understood and universally admitted, but they relate to the best modes of applying ventilation under circumstances which are as various as they can be

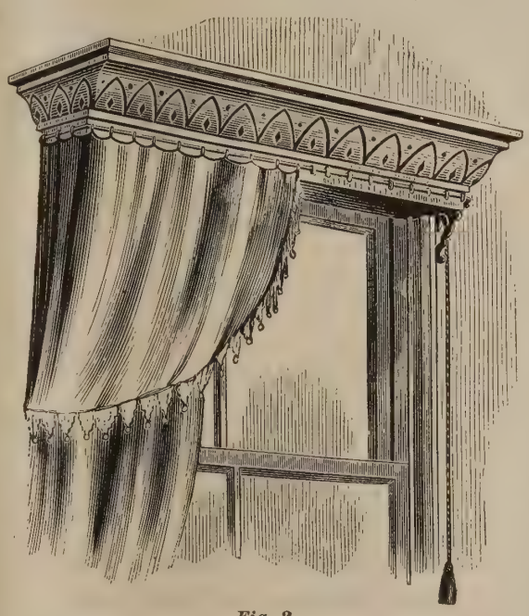


Fig. 2.

imagined. Because of these differences of opinion, and because of the real difficulty of applying a simple and universally applicable system of ventilation that can be relied upon to work satisfactorily under any and all circumstances, it has come to pass in numerous cases, that the ventilation of modern dwelling houses is left to take care of itself, the impression prevailing that it will be as well ventilated in that way as if elaborate and expensive provision had been made for securing this desideratum.

It is not to be questioned that the result of this very general neglect of so important a sanitary measure is attended with serious consequences to the health of the inmates of illy-ventilated houses, and more especially of illy-ventilated sitting and sleeping rooms.

One of the simplest modes of rectifying such neglect would appear to consist in applying to such apartments some simple and inexpensive arrangement by which a constant supply of fresh air from without could be supplied to them in such quantity as would be sufficient to meet the requirements of wholesomeness and in such a manner as shall not interfere with comfort. We illustrate and describe in what follows an ingenious attempt to meet the requirements above named.

The inventor's efforts have been directed, in the automatic ventilator shown in the annexed cuts, to secure the admission of a constant supply of pure air into the apartment from the top, without causing a draft upon its occupants; to have the incoming air sufficiently warm in cold weather, to cause no discomfort to the occupants; and at the same time to provide a vent by which the vitiated air may escape.

How this is to be accomplished will appear from the following description of the device which is known as "Sayers' Automatic House Ventilator."

The inventor provides an air-duct at the top of the window (Fig. 1) by which fresh air from without enters the apartment. The arrangement of the air-duct directs the entering air upwards towards the ceiling, where it is distributed, and gradually circulates throughout the room, without causing an uncomfortable draught, displacing the vitiated air which escapes by the ventilator. The ventilator is automatic in action, and requires no attention, even in very stormy weather, as the outer openings of the air-duct are protected by pivoted guards which close in high wind, thus preventing too strong a current from blowing into the room, and preventing the entrance of dust. When the wind lessens its force, the guards swing open automatically. The advantages of the peculiarities just named will be apparent, and specially adapt this apparatus for sleeping apartments, as the doors and windows may be securely locked while a free circulation of fresh air is secured, and the occupants subjected to none of the discomforts of an open window.

Should it be desired at any time to close the ventilator entirely, this may be accomplished by pulling a cord which hangs down at the side of the window, and which is attached to the valve (seen in Fig. 1); by releasing this cord, the valve falls open by its own weight. Another peculiar feature of this ventilator, is the fact that the air duct is formed into a cornice of any ornamental design at the top of the window in the inside of the room (Fig. 2). It is independent of either sash, and does not interfere with lowering or raising them; it does away with the necessity of hanging them with weights for the purpose of ventilation, and does not in any way interfere with hanging the curtains in the usual way. The ventilator is completely hidden from view in the interior of the room by the curtains or lambrequins, and on the exterior of the building it presents the appearance of a neat Venetian blind above the sash, and is an embellishment rather than otherwise. A netting spread over the inner opening of the air-duct affords an effectual protection against the entrance of insect pests. The ventilator in no wise interferes with the use of Venetian blinds, outside sash for winter, or the raising and lowering of either the upper or lower window sash. The inventor claims for it the hearty approval of sanitarians and architects to whom it has been exhibited, and that its practicability in service has been abundantly proved.

This apparatus has been protected by letters-patent in Canada and the United States, and is the invention of Mr. W. S. Sayers, Guelph, Ontario, Canada, to whom inquirers desirous of cooperating with the inventor in introducing its manufacture throughout the country may be addressed.

Sanitary Errors.—It is a popular error to think that the more a man eats the fatter and stronger he will become. To believe that the more hours children study the faster they learn. To conclude that if exer-

cise is good, the more violent the more good is done. To imagine that whatever remedy causes one to feel immediately better is good for the system, without regard to the ulterior effects.

Nervous Epidemics in Schools.

A singular epidemic, which is reported as having broken out in a girls' school in Ohio, is worthy of notice, as illustrating the force of the imagination in susceptible persons. We give the account as it has been published:

"A singular calamity has befallen the Ursuline Convent, a famous Catholic institution, in Brown county, Ohio. The trouble is the breaking out, in epidemic form, among the pupils, of St. Vitus dance. The malady made its appearance two or three weeks ago, but was not considered serious until within a few days, when, finding it had become epidemic, and in one case at least had resulted fatally, the parents of the pupils were requested to remove their children. The symptoms attending the first case were those usually accompanying this disease; first, an involuntary motion of the shoulders, then a growing of the symptoms into the other portions of the body, a contraction of the muscles of the arms and face, a slight nausea and headache. The physician of the institution, Dr. Hall, of Fayetteville, was called in, and the ordinary prescription for such cases administered. The patient, a girl of perhaps twelve, stated that she had never been subject to any attacks of this nature, but that an elder sister had been so troubled. On the next day two more of the pupils were similarly attacked. On the following day there were more, and as the days and weeks went by, more and more of the inmates of the convent became subject to this strange illness, until probably twenty or more of the pupils and a dozen or more of the Sisters in attendance had been attacked with this strange and unaccountable epidemic, for such it now appears to be. On Wednesday morning the doctor was sent for in great haste, and on arriving, found ten new patients jerking and hopping, and gaping and twisting their faces into inconceivable shapes; and even while he was present two or three more were taken with the strange symptoms, and fell to jerking and twisting in the same manner as those who had preceded them in this singular experience. Then the doctor and the Sisters, who had been gradually growing alarmed, took thorough fright, and the school was called up—the portion able to answer to the call—and hurriedly dismissed, the daily omnibus and barouche and a convenient spring wagon pressed into service, and as many of the pupils as could be got off on so short a notice, were hurried to the depot and sent to their homes by the first train.

"As soon as the disease came to be recognized, it was observed that those witnessing its operations upon others soon came to be affected by it, and the patients were kept excluded from the society of the others. As the number grew, it became necessary to place several of the afflicted in the same apartments during the presence of the physician, and here some very strange scenes have taken place. Dr. Hall, at first believing that the action of the mind would have a very considerable effect in the treatment of the disease, tried to induce the patients to overcome by will-force the strange motions of the various portions of the body. To this act he persuaded those whose arms were affected, to try to carry steadily across the room a shallow tin pan containing half a dozen marbles, without spilling the marbles on the floor. These tests resulted in some cases satisfactorily, in other cases in the marbles being thrown almost to the ceiling and scattered in showers about the room. With only a very few exceptions, the cases have been confined to the convent, yet there have been enough outside to raise a question as to whether it was peculiar to the community in this particular building. There were in the convent seventy pupils, and a like number of Sisters, who have charge of the various departments. In some of them it is much less violent than in others."

Not many years ago—say a century or two—such an outbreak as the above would have been looked upon as a clear manifestation of a supernatural power, and, according to the popular opinion that might happen to prevail, the exhibition would have been attributed to good or to evil influences. Nowadays, however, the eye of science sees in these singular performances simply a nervous disease—*chorea*—which is especially liable to occur in children between the ages of 10 to 15, and to affect girls more especially, though it is not strictly confined either to children or to one sex.

The name, St. Vitus dance, which is popularly given to this singular affection, is a relic of Middle Age superstition, and the disease of the children of the Ohio convent is essentially of the same nature as the epidemics which were turned to account in those days to excite religious fervor, or to rid the community of witches. We need only refer the reader to the pages of history which relate to the persecution of the witches in England, and in Salem and elsewhere in the early history of this country, the mewing nuns, the "convulsionnaires" of St. Medard, and in our own times to the dancing dervishes of the East, to show that all of the manifestations of nervous disorder are essentially the same in character.

Physicians have repeatedly noticed that chorea is liable to break out in strange forms. In schools, among growing girls, it is not uncommon for one child with a nervous twitching of the muscles of the face or arm, to set the whole school twitching through unconscious imitation. When this occurs, as witness the case we are considering, the only thing to be done is to remove the predisposing cause—to separate them, to remove them from the unwholesome surroundings that have predisposed them to the affection, and apply the wholesome tonic effect of fresh air and plenty of physical exercise.

The Cincinnati Exposition.

The eighth annual exhibition of Art and Industry at Cincinnati, is in preparation, and, according to all accounts, promises to compare favorably with any of the preceding ones. This institution is not a private enterprise, but is supported by a public guarantee fund, under the auspices of three of Cincinnati's trade associations, and the people of that city certainly deserve no small amount of credit for their efforts to promote this worthy enterprise. The success of the project is now an assured fact, and a fine permanent building—at once a model of convenience for exhibitors and an ornament to the city—testifies that the institution is on a substantial basis. Cities in other sections of the country will do well to imitate Cincinnati's example.

The importance of such exhibitions to manufacturers, mechanics and the business community generally, cannot be over-estimated, neither can any territorial limit to the spread of their influence be drawn. The Cincinnati Exposition has not been merely of local benefit, but its salutary influence has extended throughout the entire Western country. This year's exhibition, which opens on September 8th, and closes on October 9th, cannot fail to be of special significance at this season of renewed confidence and awakening business prosperity.

Miscellaneous and Advertising.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

The Hazard M'fg Co., of Wilkesbarre, Pa., the well-known manufacturers of steel and iron wire ropes, have the largest and most perfect rope-making machinery in the world, and, using none but the very best materials, have acquired a world-wide celebrity for their productions in this line.

The metallic shingles of the Iron-Clad M'f'g Co., of 22 Cliff street, this city, have won since their introduction a well-deserved reputation by reason of the many points of superiority which this style of roofing possesses. The shingles are thoroughly fire-proof, and owing to the novel manner in they are laid, allow of contraction and expansion, and thus are free from all danger of leakage. They are, besides all this, light, ornamental and durable. We advise parties about roofing their houses, to send to this company for their circular and price-list.

A suit brought by J. R. Robinson against the Hartford Steam Boiler Inspection and Insurance Co., to recover $25,000 damages for alleged libel, has been decided in favor of the defendants. The suit was the outcome of some strictures made by Mr. Allen, President of the Hartford Company, on the testimony given by the plaintiff in Cambridge, Mass., in April, 1878. A horizontal tubular boiler, 48 inches in diameter and 17 feet long, exploded, killing three persons; an inquest was held, and the plaintiff in the present suit was called as a witness to give his theory of the explosion, which he also afterwards published in pamphlet form. His erroneous theories were answered by Mr. Allen in articles published in the *Scientific American* and *Locomotive*, and these formed the basis upon which suit was brought.

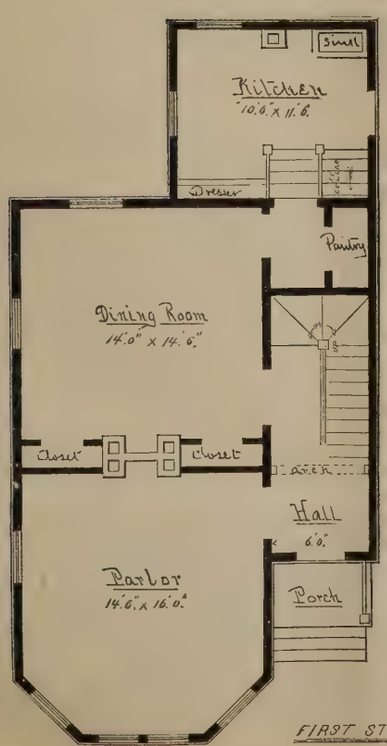
Design for Dwelling.

The design shown on the opposite page has many points to commend it to one desiring to build at moderate cost, a suburban home, comfortable in its interior arrangement, and pleasing as regards the external appearance. Referring to plans, on the first floor are two rooms and ample pantry and closet room with stairs leading from pantry to cellar. An exceedingly cheerful appearance is given to the front room by the octagon arrangement of end. The second story has three bed-rooms all well lighted and each having a clothes-closet. There is a well lighted and ventilated cellar under the entire house, with two entrances and having a clear hight of 6 feet 9 inches. The hight of the first story is 10 feet, and of the second story 9 feet 6 inches. The wood-work of the interior is pine, and the frame of building hemlock, of the following scantling: Sills, 4x6 inches, halved together at angles; posts, 4x6 inches; studs, 2x4 inches, set 16 inches from centers; floor joists 2x10 inches, 16 inches from centers; plates, two 2x4 inches spiked together; rafters, 2x6 for pitch, crowed on to plate, and set 20 inches from center; girders in cellar, 6x8 inches, supported by 6-inch chestnut posts, set on flat stones. The foundation is of stone, laid up in cement. The roof is shingled and tinned. The chimneys are of hard brick The entire building, outside and inside, is painted in two coats.

The architects of this admirable design are Messrs. Clarence W. Smith and Augustus Howe, Jr., of 7 Warren street, this city, another of whose productions was given in our last number and met with such general favor that we publish the present design with particular pleasure, feeling confident that it will be received with equal satisfaction.

Our readers will remember that the design we gave last month received the first prize at the Fair of the New Jersey State Agricultural Society at Waverly last fall. We may add that the present design was awarded the second prize and was highly commended for its many meritorious features. At the time the design was exhibited its cost was estimated at $1,500, but the advance in articles of building makes it necessary to change these figures to $1,800, for which sum the architects claim this house can be erected in New York City or vicinity. Last month the types made us say in referring to the sum for which the house, given in that issue, could be built: "The house was then estimated at $1,000, but the recent rise in the price of material renders it necessary to increase this estimate about a third, making the estimated cost at the present time $1,500."

It is apparent that instead of "about a third" one half should have been stated as the proportion of increase.



DESIGN FOR DWELLING,
COSTING $1,800.

A Library 4,000 Years Old.

The recent address of Chief Justice Daly before the American Geographical Society, contained an extensive reference to the remarkable discovery of the late Mr. George Smith, the eminent archæologist, beneath the ruins of what was once Nineveh, of the remains of what had been a great Assyrian library. The materials of this collection were of baked clay, and had proved so indestructible that Mr. Smith was able from the fragments to recover over 3,000 inscriptions, forming pages of the volumes of which the library was composed, and in some cases to recover complete books. The tablets or leaves of these volumes are formed of thin plates of clay, on either side of which the text was inscribed, the tablets being afterwards baked or dried, when the same, like our modern book, were arranged in chapters and volumes. Nearly two-thirds of this library is now in the British Museum, and is found to embrace works on history, astronomy, geography, religion, morality, astrology, and other subjects.

From one of these books, compiled after the manner of our modern encyclopædias, and the compilation of which is shown to have been made more than 2,000 years B.C., it has been ascertained, what has long been snpposed, that Chaldea was the parent land of astronomy, for it is found, from this compilation and from other bricks, that the Babylonians catalogued the stars, and distinguished and named the constellations; that they arranged the twelve constellations that form our present zodiac to show the course of the sun's path in the heavens; divided time into weeks, months and years; that they divided the week, as we now have it, into seven days, six being days of labor and the seventh a day of rest, to which they gave a name from which we have derived our word "Sabbath," and which day, as a day of rest from all labor of every kind, they observed as rigorously as the Jew or Puritan. The motion of the heavenly bodies and the phenomena of the weather were noted down, and a connection detected, as M. de Perville claims to have discovered, between the weather and the changes of the moon. They invented the sun dial to mark the movements of the heavenly bodies, the water clock to measure time, and they speak in this work of the spots on the sun, a fact they could only have known by the aid of telescopes, which it is supposed they possessed, from observations that they have noted down of the rising of Venus and the fact that Layard found a crystal lens in the ruins of Nineveh. These "bricks" contain an account of the Deluge, substantially the same as the narrative in the Bible, except that the names are different. They disclose that houses and land were then sold, leased, and mortgaged, that money was loaned at interest, and that the market gardeners, to use an American phrase, "worked on shares," that the farmer, when ploughing with his oxen, beguiled his labor with short and homely songs, two of which have been found, and connect this very remote civilization with the usages of to-day.

The Hudson River Tunnel.

The work upon this improvement, which has suffered such delay from legislation and other causes, is now steadily pushing forward, and those in charge of it affirm that, save for unforeseen disaster, in three years from the present, trains arriving in Jersey City will be run directly through to New York. Thus far, the work has been confined to the New Jersey end, but preparations are now making to start from the other side, and the work will be pushed from both ends. The entire length of the tunnel will be 12,000 feet. The tunnel will be lined with heavy iron plates, and these in turn will be faced with hardened bricks and hydraulic cement, three feet thick. The interior will be painted white, and lighted with gas. It will be provided with a double track, and the company calculates that, with the facilities at command, it will be easy to pass 400 trains through the tunnel every twenty-four hours. The traffic it is intended to so divide that freight trains will use the tunnel exclusively at night; and market trains in the early morning; the rest of the day being reserved for passenger traffic.

The trains will be provided with engines supplied with smoke and steam-condensing devices, so that the air of the tunnel shall not be vitiated, and special ventilating machinery will also be provided for the same purpose.

Some peculiarities in the form of the tunnel are of interest. It is to be a single one, 26 feet wide and 24 feet high in the clear, down to within a few feet of the river, on both sides, and a double one all the way under the river, where the two tunnels will run side by side, each 18 feet high and 16 feet wide. It will extend from Jersey avenue, at Fiftieth street, in Jersey City, beneath the river, curving slightly northward, to the New York bulkhead line at or near the foot of Morton street; thence, curving southward some 3,000 feet, to a point to be selected by the city authorities. The plan of introducing compressed air directly into the face of the tunnel, and dispensing with much expensive machinery (caissons, shields, etc.) generally used in this class of work, was first suggested by Mr. Haskin, the President of the Tunnel Company. It is said to work in all respects satisfactorily. The work, it is expected, will be completed at a cost not exceeding $10,000,000.

BENZOATE OF SODA FOR DIPHTHERIA.—The following paragraph is being widely circulated, viz.: Prof. Kelbs, of Prague, announces that the benzoate of soda is the best antiseptic in all infectious diseases. It acts, as the experiments of the author show, very powerfully. It is claimed that a daily dose of from 30 to 50 grammes to a full-grown man will render the poison of diphtheria inoperative. The benzoate is prepared by dissolving crystallized benzoic acid in water, neutralizing at a slight heat with a solution of caustic soda, drying, and then allowing the solution to crystallize over sulphuric acid under a bell glass. Large doses do not appear to be absolutely necessary. Good results may be obtained by the daily administration of about 12 grammes.

New Publications.

Schiller's Complete Works. Edited, with Careful Revisions and New Translations, by Charles J. Hempel, M.D. In Two Volumes, with Illustrations by the best German Artists. Philadelphia: I. Kohler, 911 Arch street. 1879. Price $4.50 to $18, according to style of binding, etc.

Mr. Kohler has just issued an English edition of Germany's most popular and best beloved poet. The work is in two volumes, imperial octavo, printed in large, clear, legible type, and adorned with fifty-six full-page illustrations. The selection of the numerous translations of the poet has been judiciously done by the editor, and their meritorious character is vouched for by the names of Bulwer, Coleridge, Melish, Churchill, Morrison, and others almost as widely and favorably known. We have spent several enjoyable evenings in the task of comparing the original with the English version, and find that the version chosen by Dr. Hempel reproduces as faithfully as is possible of accomplishment, the meaning and the spirit of the author. The name of Schiller occupies among German-speaking people the place of Shakespeare with us, and to the great number of his American admirers the issue of a first-class English edition of his works, at a price within the reach of even slender purses, will be hailed with satisfaction. The publisher announces also that the work will be furnished either complete in any style to suit individual tastes, or in parts of twenty-four numbers, at 25 cents each.

American Health Primers. "Hearing, and How to Keep It." By Charles H. Burnett, M.D., Consulting Aurist to the Pennsylvania Institution for the Deaf, etc. Price 50 cents. "Eyesight, and How to Care for It." By Geo. C. Harlan, M.D., Surgeon to the Wills Eye Hospital, etc. Price 50 cents. Philadelphia: Presley Blakiston. 1879.

We take pleasure in noticing two useful additions to the excellent series of "American Health Primers," to which we have referred in terms of commendation in our former issues. The two works here named fully maintain the high standard of the series. Dr. Burnett, in "Hearing, and How to Keep It," treats the structure of the ear; physics and physiology of sound and hearing; the chief diseases and injuries of the ear, and the avoidance of their improper treatment; and of the general hygiene of the ear—that is, the care of the ear in health and disease.

Dr. Harlan, in "Eyesight, and How to Care for It," discusses the anatomy of the eye; the physiology of vision; injuries and diseases of the eye; optical defects; spectacles; and gives a chapter of practical suggestions for the care of the eyes, and on the effects of school-life upon the sight.

The Carpenter and Joiner Modernized. Explaining the Utility of the Slide-Rule. By Robert Riddle, Teacher of the Artisan Class in the Central High School of Philadelphia, etc. Philadelphia: Claxton, Remsen & Haffelfinger. 1880. Price $7.50.

This is a third edition of Mr. Riddle's standard work, revised and corrected. It contains new matters of interest to the carpenter, stair-builder, carriage-builder, cabinet-maker, joiner and mason. In this, as in the earlier editions of the work, Mr. Riddle lays special stress on the utility of the slide-rule, of which he gives lucid examples of its accuracy in calculation, showing it to be indispensable to every workman in giving the mensuration of surfaces and solids, the division of lines into equal parts, circumferences of surfaces, length of rafters and braces, board-measure, etc. The work is illustrated with 32 full-page engravings, illustrating graphically the methods of solving most of the practical problems that are presented to the artisan.

A Practical Treatise on High-Pressure Steam Boilers. Including Results of Recent Experimental Tests of Boiler Material, together with a Description of Approved Safety Apparatus, Steam Pumps, Injectors and Economizers in Actual Use. By William M. Barr. Indianapolis: Yohn Brothers. 1880. Price $4.

We can warmly recommend this book to our mechanical readers as one of the best that we have met. It has evidently been written by a person who is thoroughly at home with both the theory and the practice of the subject he handles; and it will be found to contain nearly everything of importance and of interest in relation to the steam boiler—its materials, appliances, and practice. The style of the author, too, is excellent, being clear and concise—an admirable exception to the class of works often miscalled "practical," and which on inspection are found to be indifferent compilations of other men's sayings and opinions expressed in execrable English.

How to Educate the Feelings or Affections. By Charles Bray. Edited, with Notes and Illustrations, from the Third London Edition, by Nelson Sizer, Author of "How to Teach," etc. 12mo, extra cloth. Illustrated. Price $1.50. New York: S. R. Wells & Co.

This is a text-book of phrenology applied to the problem of the culture and regulation of the feelings or affections. The leading idea intended to be impressed by the author upon his readers, is certainly praiseworthy, this being to inculcate the doctrine that the passions and propensities of mankind can be educated so as to make them subservient to moral and social law. No one can object to so admirable a purpose as the author manifests, no matter what opinion he may entertain concerning the value of phrenology as a guide to the estimation of disposition and character.

Brain and Mind; or, Mental Science Considered in Accordance with the Principles of Phrenology, and in Relation to Modern Physiology. By Henry S. Drayton, A.M., and James McNeill. Illustrated. Extra cloth; one vol., 12mo, pp. 334. Price $1.50. New York: S. R. Wells & Co.

The above work is another contribution to the already extensive literature of phrenology, and those who are interested in this science will find it to treat of the subject quite extensively. The book is fully illustrated with engravings exhibiting the various mental qualities and characteristics.

The Slide-Valve Practically Explained, etc. By Joshua Rose, M.E. Illustrated by 35 Engravings. Philadelphia: Henry Carey Baird. 1880. Price $1.

This work is from the pen of a well-known writer on mechanical subjects, himself a thorough practical mechanic. It presents a clear explanation of the operations of the slide-valve under the conditions in which it is found in actual practice. The examples presented in elucidation of the subject are drawn from the best practice.

Multiplication and Division Table; containing the Products of Numbers between 1 and 100, for the Use of Accountants, Computers and Teachers in the Primary Schools. By Leonard Waldo, S.D., (Harvard), Astronomer in the Winchester Observatory of Yale College. New York: John Wiley & Sons. Price 75 cents.

This table is deserving of much praise, and the author is to be thanked for the painstaking manner in which he has accomplished his work. The tables at present in use are more or less objectionable, and even Crelle's "Rechentafeln," which has been hitherto considered one of the best, is too bulky, and omits the 10's—a great drawback, and one by which every computer is inconvenienced. By the use of Dr. Waldo's tables, accountants and book-keepers will find their work much facilitated and an increased accuracy insured. To teachers in primary school and business colleges it will also prove useful.

OTHER PUBLICATIONS RECEIVED.

Quarterly Report of the Chief of the Bureau of Statistics, Treasury Department, Relative to the Imports, Exports, Immigration and Navigation, of the United States for the three months ending December 31st, 1879; also containing other statistics relative to the trade and industry of the country. Washington, D. C.: Government Printing Office.

We are indebted to the American Institute of Mining Engineers for the following papers: The Mineral Resources of Southwestern Virginia, by C. R. Boyd, Wytheville, Va. Notes on Battery and Copper-Plate Amalgamation, from the Mining

Laboratory of the Massachusetts Institute of Technology, Boston, by Robert H. Richards, S.B., Professor of Mining. Fuel-Gas and the Strong Water-Gas System, by Dr. Henry Wurtz, New York city. The Claiborne Group and its Remarkable Fossils, by Prof. P. H. Mell, Jr., Auburn, Ala. Proceedings of the Annual Meeting held in New York, February, 1880. Notes on the Siemens Direct Process, by A. L. Holley, C.E., LL.D., New York. The North Staffordshire Coal and Iron District, by Wm. Hamilton Merritt, St. Catharines, Canada. The Heat of the Comstock Lode, by John A. Church, E.M., Ph.D., New York City. Notes on the Blast Furnace, by J. M. Hartman, Philadelphia. Blast Furnace Working, by Julian Kennedy, Edgar Thomson Steel Works, Pittsburgh, Pa. The Puddling Process, Past and Present, by Percival Roberts, Jr., Philadelphia. The Successful Manufacture of Pressed Fuel at Port Richmond, Philadelphia, Pa., by E. F. Loiseau.

Correspondence.

COTTON BELTING.

To the Editor of the Manufacturer and Builder:

Some two years ago we had the name of, and communicated with, a firm in New York, who manufactured cotton belting and (we think) hose, but have lost both their name and address. Will you, therefore, kindly give us the name and address of any firm, or firms, in this line of business, either in New York or elsewhere, that you may know of or can ascertain, and much oblige.

Our object in writing to such a firm, is to learn if we can procure *round* cotton belting of about one inch diameter. We have lately been experimenting to overcome the use of rubber belts for transmitting power from an engine to a threshing machine, which are objectionable in wet or windy weather, and very expensive. In using a hemp rope, we have found that we can make the pulleys of proper shape that the rope would run in them with two or three laps around each pulley, and without climbing, binding or chafing. The size of threshing machine pulley is about 7 inches, and engine pulley 3 feet 6 inches; usual width of rubber belt 6 inches, and horse-power 12. We now want to get something better than hemp rope, if possible, hence our inquiry for round cotton belting. We would be pleased to receive any advice or information you could give us in regard to which kind of round belting or rope would be most suitable, the durability or lasting qualities of different kinds, the proper size to transmit 12 horse-power, and the most serviceable in wet weather. Neither wire nor leather would answer, wire not being pliable enough to "grip" a small pulley, and leather unfit for use in wet weather.

Clinton, Ontario, Canada, April 2, 1880. G. M. & Co.

ANSWER.

We have sent to these correspondents the address of a firm from whom they can obtain the kind of cord they ask for, and which is a standard article for the purpose for which they want to use it. The party referred to keeps sizes ranging from ¼ to 1¼ inches in diameter, and of the best quality. It is selling at 35 cents per pound at the present time, varying slightly in price as other goods do. A cheaper article can be bought at say 28 cents per pound, but it is dear for their purpose at any price. Some parties use this cord in the condition as purchased —that is, without any preparation being put upon it; but for out-doors or exposure to dampness, a mixture of beeswax and pulverized plumbago is recommended as a help to adhesion as well as a protection against excessive abrasion and the effects of the weather. It is recommended to have the grooves in the pulleys of a shape to fit the rope on its driving semi-circumference, and not V-shaped, which wears the rope faster, because the contact surface of rope with pulley is narrowed to two lines of touching in the angular notch.

It is difficult to tell exactly what power may be transmitted by cords of this kind, because the circumstances of use vary so much. With round ropes, pulley contact is small and internal wear of rope great by reason of continual bending. If wound several times around the pulleys, as you suggest, the transmitting power of any rope is limited only by its tensional strength.

We make a selection from Mr. J. H. Cooper's "Use of Belting," which may throw some light on the use of round cotton cords for transmitting power to distances beyond the range of leather belting, giving also some figures of the continuous stress which may safely be put upon them:

"*Rope Gearing.*—In a paper by Mr. John Ramsbottom, in *Newton's Journal*, Vol. XXI., page 46, on traversing cranes at Crewe Locomotive Works, dated January 28, 1864, mention is made of the means by which power is communicated from the shop lines of shafting to the gear of the cranes. It consists of a ⅝-inch diameter, soft, white cotton cord, weighing about 1½ ounces to the foot, running at the rate of 5,000 feet per minute, in a line with the longitudinal motion of the crane, above the same, and over a 4-foot diameter tightener sheave. This sheave is weighed so as to put a tension on each strand of the cord of 108 pounds, which is found to be the best working strain for keeping the rope steady, and giving the required 'hold' on the main driving pulley. The cranes have a span of 40 feet 7 inches, a longitudinal traverse of 270 feet, and the rails are 16 feet above the floor. The cord is supported every 12 or 14 feet by cast-iron fixed slippers of plain trough section, 1⅜ inches wide, with side flanges. These slippers are placed 1½ inches below the working line of the driving side of the cord, so as to allow the driving wheels on the traverser to pass them. They are not oiled, and the friction of the cord in them amounts to two-5ths of the working load. Motion is communicated to the gear of the crane by pressing the cord into grooved cast-iron pulleys. The grooves in the driving pulleys are V-shaped, at an angle of 30°, and the cord does not touch bottom. The guide pulleys have circular grooves, same diameter as the cord, and the pressure pulleys have a circular groove of larger diameter than the cord. The driving pulleys have a diameter equal to 30 times the diameter of the rope. Guards are put on the pulleys to keep the ropes in. The driving power of the cord to lift 25 tons is only 18 pounds, irrespective of friction, which is a ratio of 3111 : 1. Light loads are about 800 : 1. In the gib cranes, driven by similar means, the ratio is 1000 : 1, when lifting 4 tons at the rate of 5 feet 1½ inches per minute. The actual power required to lift 9 tons, besides the snatch-block and chain, has been found to be 17 pounds at the circumference of the driving pulley. The crab, when unloaded, requires 1½ pounds to overcome its friction. The cords are soon reduced to nine-16ths of an inch diameter, and last about eight months at constant work. In an overhead traverser, used in the boiler shop, lifting six tons, three years in use, a ⅜-inch cord was employed, but was afterwards changed for a cord ½ inch in diameter.

"The light driving cord is the only plan compatible with high speeds—a heavy chain, belt or cord would soon wear out and break by its own weight."

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2629) What is Water Gas?—I will be obliged to you for a scientific definition of what water gas is? I understand that it is made by decomposing water, and that great gains in heating effect are claimed in using it. Your answer will oblige.—F. A. O., Philadelphia.

(2630) Problem of a Marching Column.—We have been unable to solve the following problem, and send it to you with the request that you will help us to the right method of solution. It looks easy enough, but two or three of us have tried our hands at it and have failed. We neither agree with each other in the statement of the problem, nor in our answers. This is the problem: There is a marching army, the column of which is 25 miles long. The general in command rides from the front of the marching column to the rear, and returns again to the front; he then halts the column, and finds that during his ride from front to rear and return, the army has marched 15 miles. *Question:* How many miles did the general ride? The correct answer is said to be 60 miles; but we have not been able to bring it out. Your reply will oblige.—A. R., Carlisle, Pa.

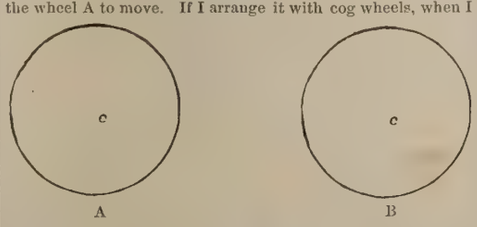
(2631) The Treatment of Imaginary Quantities.—The replies given to Queries 2421 and 2452 in your July and September numbers for 1879, relating to the "treatment of imaginary quantities," have been questioned by several teachers here. Will you please give your answer to these questions, and oblige. M. S. H., Knightville, Me.

(2632) Isodimorphous.—What is the meaning of the term "isodimorphous"? It seems to me to be a contradictory term. I can find no explanation of it.—J. B. E., Elkton, Md.

(2633) Concerning Electro-Plating.—Are there not methods for getting an electro-deposit of other metals besides nickel, silver, etc.? I would like some information, if you can give it, on a cheap substitute for nickel-plating.—N. M., Philadelphia.

(2634) Copper-Nickel Alloys.—Is there an alloy of nickel and copper? What is its appearance? Where can specimens be found? What are the relative proportions of nickel and copper?—G. N., New York City.

(2635) Wheel Motion.—I have two wheels (A and B) on the same axis, running through *c*. I wish to arrange the wheels in some manner, so that if I turn the wheel A four times it will turn the wheel B once, and if I turn the wheel B I do not wish the wheel A to move. If I arrange it with cog wheels, when I



turn B the A will move also. I think it might be arranged with some kind of a catch on the side of the wheel. If you can give any information on this matter, I would be much obliged.—F. L., North Weymouth, Mass.

(2636) Concerning Celluloid.—In your article on celluloid, published several months ago, you state that it is a species of solidified collodion, made by dissolving gun-cotton in camphor with the aid of heat and pressure. If this is so, is not the material explosive? Is not its manufacture very dangerous? I have also read that the statement that celluloid contained gun-cotton is an error, and that it is made of tissue paper, or paper pulp, treated by some chemical process not explained in detail.—E. N. K., Savannah, Ga.

(2637) Rules for Pipes and Passage of Gas.—Can you give a plain rule for calculating the diameter of a pipe when the amount of gas, length of pipe, pressure, and density of the gas are given? Also for finding the amount of gas which can pass through a pipe, with the same terms given? By answering the above you will greatly oblige a constant reader.—E. B. K., Manayunk, Pa.

(2638) Works on Air Compressors.—Will you be kind enough to refer me to some books on air compressors. I am preparing a thesis on the subject, and find it difficult to get at its history. Is there any published in book form?—C. L. N., Worcester, Mass.

(2639) Varnish for Colored Prints, Etc.—Can you give a recipe for a varnish or composition that will do to use with colored drawings and prints, so as to make them look like oil paintings? The parties who make a specialty of this kind of work have some kind of composition that answers very well, but I have not been able to imitate it. Please answer and oblige.—W. L., Vineland, N. J.

REPLIES.

(2587) The Strong Water Gas Process.—Referring to the inquiry of B. H. B., of Philadelphia, respecting Strong's water gas process, which we answered in our issue of March last, we wish to add for his information that the projected illuminating gas works there referred to, are now in course of erection. Yonkers, N. Y., is the town referred to, and the company is known as the Yonkers Fuel Gas Co.

(2588) Aluminum.—Referring to our answer to J. C. T., of Pittsburgh, Pa., in our March issue, we can now add to our answer that the manufacture of aluminum has just been introduced on a large scale in Philadelphia, by the Pennsylvania Nickel Works (corner Auburn and Amber streets). This company claims to have a process of producing aluminum by a new and direct method, dispensing with the use of sodium, the necessity of using which has been one of the principal causes of the high price of the metal. This company claims to be in position to very greatly cheapen the cost of producing aluminum, should the demand become great enough to enable them to manufacture it in large quantities. It may be that our correspondent will find it to his interest to communicate with the company at the above-named address.

(2629) What is Water Gas?—Our correspondent is right in supposing that what is known in popular parlance as water gas "is made by decomposing water;" but the manner of his inquiry is such as to leave the impression that he supposes the resulting product to be the decomposed elements of water—namely, hydrogen and oxygen, as they would be left, for example, after the decomposition of water by the galvanic current. This error, which is a very common one, we take this opportunity of correcting without special reference to F. A. O. Water gas we may define to be the gaseous product resulting from the interaction of steam and carbon at a high temperature. Generally speaking, the mode of its manufacture is to pass steam through a thick layer of glowing coal. The result of this procedure will be very easily understood by reference to the following explanation: The glowing coal (carbon) seizes upon the oxygen of the steam uniting with it to form carbonic acid and liberating hydrogen, according to the following reaction: $C+2HO=CO_2+2H$. The carbonic acid thus formed is, however, obliged to pass through a considerable layer of glowing coal (carbon) before it can escape, and this carbon has so strong an affinity for oxygen that it deprives the carbonic acid of one equivalent of its oxygen, reducing it to the state of a lower oxide of carbon, after the manner shown in the following reaction: $CO_2+C=2CO$. The product which results from these several reactions is, therefore, 2 equivalents of hydrogen and 2 equivalents of carbonic oxide; or, expressed in chemical language, $2H+2CO$. This product is what is known as water-gas. It is incorrect to assert that any positive gain in heating effect is obtained by this process, for the energy expended in the process of decomposing the water is precisely equal to the additional heat given out by the combustion of the water-gas over what would have resulted from the combustion of the carbon alone. On theoretical grounds, therefore, there can be no economy in the process; but there is a gain in practice, and this is due to the fact that the combustion of a gaseous fuel can always be effected with greater economy in our furnaces, stoves, etc., than that of a solid fuel. The gain, therefore, is to be ascribed to the physical condition of the fuel, and not to any advantage resulting from the chemical reaction that has taken place. This is a very common error that is entertained even by otherwise well informed persons. We look upon the future of water-gas as highly promising. With its aid it is made possible to produce illuminating gas more cheaply than by any other process, by simply enriching it with the vapors of petroleum, or of other substances rich in illuminating elements. But the grand field of water-gas for the future will lie in filling the place of a *fuel* for industrial and domestic uses to take the place of coal. We think the time is not very remote when water-gas will be distributed to our houses just as coal-gas is now distributed—when coal and wood fires, with their abomi-

nations of dirt and ashes, will be only known as things of the past.

(2630) Problem of a Marching Column.—The problem stated by A. R. may be solved as follows: Let r=the general's rate of motion, that of the army being taken as 1. Let x=the distance the army marches while the general is riding down the column. Then rx=the distance the general travels in that time; $15-x$=the distance the column travels while the general returns; and $15r-rx$=the distance the officer travels on his return; but $x+rx=25$ (1); and $15r-rx-(15-x)=25$; or, $15r-rx+x-15=25$; and by combining this by addition with (1) $15r+2x-15=50$.

But from (1) $r=\frac{25-x}{x}$; therefore $\frac{375-15x}{x}\times 2\times -15=50$;

or, $375-15x+2x^2-15x=50x$, or $2x^2-80x=-375$, from which $x=5$. Substituting this value of x in equation

$$r=\frac{25-x}{x}, \text{ we have } r=\frac{25-5}{5}, \text{ or } r=4$$

The entire distance the general travels is $rx+15r-rx=15r$, or 60 miles.

(2631) The Treatment of Imaginary Quantities.—The examples originally given by our correspondent seem to be misquoted, for in the "Olney" that we have, the radicals are mostly fourth and sixth roots, and the respective quantities under them are treated on the principle that $\sqrt{-a}\times\sqrt{-a}=-a$; and accordingly have their proper solution. There is considerable difference of opinion as to how imaginary quantities should be treated. Some authorities—as, for example, our learned predecessor—seem to think that they should be treated as "unthinkable" quantities, and that that portion of them which constitutes their unthinkableness—that is, $\sqrt{-1}$, should be treated like an indestructible coefficient. On this very point, Olney states, and Alsop seems to be in accord with him, that "it is a mistake to suppose that such expressions are in any proper sense more unreal than other symbols. The term 'impossible quantities' should not be applied to them—it conveys a wrong impression. The question is, not whether the symbols are symbols of real or unreal (imaginary) quantities or operations, but what interpretation to put upon them, and how to operate with them when they occur." Therefore we are not justified in stating that $\sqrt{-1}\times\sqrt{-1}=\sqrt{(-1\times-1)}=\sqrt{+1}=1$, but must give it the double sign, and knowing what factors were multiplied together to produce it, we give the same negative value.

(2632) Isodimorphous.—The term is not contradictory, as will appear from the following explanation: Many substances having a similar chemical constitution, manifest a disposition, in crystallizing, to assume analogous (and frequently identical) crystalline forms. Such compounds are termed "isomorphous," from two Greek words meaning "having the same form." Such bodies are the alums, most of the alkaline, and other metallic carbonates, the spinel group of proto-sesqui oxides, etc. There are again certain compounds that do not always assume the same form in crystallizing, but crystallize at times in one system of crystallization and at times again in another, as the circumstances vary. Some even crystallize in three systems; such compounds are called "dimorphous" (having a double form), or "trimorphous" (having a triple form). As an example of a dimorphous substance, take the carbonate of lime, which occurs in the mineral kingdom in two distinct species—calcite, rhombehedral, and arragonite, trimetric. Now it occasionally happens that we meet with isomorphous compounds that present the peculiarity of being dimorphous, and it sometimes occurs, though very rarely, that such substances are isomorphous in both of the forms in which they crystallize, hence the term "isodimorphous"—that is, "having the same double form." The term is, therefore, a very good and expressive one. Take, for example, the substance carbonate of lime, which, as above noticed, is dimorphous—occurring in the form of arragonite and calcite. Now, the nitrate of soda (cubic niter) crystallizes in a rhombohedron hardly to be distinguished by its angles from that of calcite; and the prismatic crystal of saltpeter (potassic nitrate) is hardly to be distinguished from that of the prismatic arragonite. A crystal of calcite placed in a solution of sodic nitrate will grow by additions of the latter substance; and if an arragonite crystal is placed in the same solution, it will also grow, showing that this substance will, under certain circumstances, assume both the rhombehedral and the prismatic forms. Hence, we say carbonate of lime and nitrate of soda are isodimorphous. It is highly probable that the potassa salt will behave similar to the soda salt, by crystallizing over a rhombohedron of calcite, or of soda saltpeter; but thus far the experiment has not been successfully performed, so far as we know.

(2633) Concerning Electro-Plating.—Electro-plating with other metals besides those commonly employed—gold, silver and nickel—has been suggested from time to time, and processes have been described for obtaining galvanic coatings with iron, bismuth, antimony, aluminum, platinum, and possibly also with other metals. We do not believe, however, that in point of elegance and high finish any of these deposits could compare with gold or silver, or with nickel, which last is the objective point of our correspondent's inquiry. For his information, however, we will describe a procedure of a French chemist for electro-plating with bismuth and antimony, which seems to us to promise good results. By properly experimenting with these methods, perhaps N. M. may succeed in improving upon them. Both bismuth and antimony are very indifferent to atmospheric exposure, and the coating of either of these metals ought to be quite permanent. A galvanic deposit of bismuth on properly cleaned metal surfaces may be obtained, according to Bertrand, by employing the following recipe: For this purpose he employs the double chloride of bismuth and ammonium—a white, crystalline compound, very soluble in water, and not precipitated by a slight excess of hydrochloric acid. He recommends that the operation be conducted in the cold, and with a solution containing about 250 grains to the pint of water. Precipitation is easily effected with a single Bunsen element; with a Daniell it is slower. When the operation is finished, the objects—of brass or copper—will be found to have a blackish tint on the surface, below which, however, the bismuth, which adheres firmly, will be found with its characteristic luster, midway between that of antimony and old silver. The deposit takes a fine polish. In an analogous manner the double chloride of antimony and ammonium affords a galvanic deposit of antimony. We will be pleased to hear the results of our correspondent's test of these procedures should he feel sufficient interest to try them. Not having tested them ourselves, we are not prepared to say how well they will work in practice. They look very reasonable.

(2634) Copper-Nickel Alloys.—Nickel has of late been extensively employed on a large scale for the production of white alloys suitable for a great variety of uses. These alloys are known variously by the following names: Argentan (packfong), German silver, and Maillechort. They consist essentially of alloys of copper, with nickel and zinc, or with nickel, zinc and iron. The most common of these are the following: Argentan (packfong), which is largely used for buckles, harness ornaments, locks, and general hardware, as well as to counterfeit silverware, is made after the following formulas, according to the use for which the product is intended:

	No. 1.—Yellowish.	No. 2.—White.	No. 3.—White.
Copper	8	8	8
Nickel	2	3	2
Zinc	3	3.5	2

German Silver is made of		Chinese Packfong is made of	
Copper	2	Copper	10.4
Nickel	1	Nickel	31.6
Zinc	1	Iron	2.6

The white alloys known in France by the name of Maillechort, are made after the following formulas:

	No. 1.	No. 2.	No. 3.
Copper	8	8	8
Nickel	4	3	4
Zinc	3	3.5	4

The finest white alloy, for beauty, luster, etc., is said to be produced after the following proportions:

Copper	8
Nickel	6
Zinc	3.5

The foregoing alloys, our inquirer will have noticed, are not simple compounds of copper and nickel. The only alloy of copper and nickel that has been used in the arts, is the alloy composed of copper, 75 per cent, and nickel, 25. This alloy is used in our so-called nickel coins—the 3 and 5 cent pieces. Beyond this use, alloys of copper and nickel have as yet acquired no importance in the arts. Such alloys have been made experimentally, for the purpose of studying their properties, but they do not appear to have been promising enough to warrant much attention. There are none, so far as we know, to be had in the market. Besides the aboved named alloy used in coinage, the only reference in the text-books to copper-nickel alloys, is respecting a compound of copper, 2; nickel, 1. It is spoken of as a grayish-white metal, slightly crystalline at the surface, tenacious, ductile, and sufficiently fusible.

(2635) Wheel Motion.—In order to give a proper solution of this problem, it will be necessary for our correspondent to let us know something more of the conditions. Must the intermediate driving arrangement be mounted on the same axis as that passing through c? Is the power to be transmitted great or small? The difference in angular velocity can be obtained by intermediate gearing, either toothed or friction, the driving gear being revolved with the wheel having the greatest angular velocity, and the reduction being effected by intermediate gearing (two wheels—one being driven by the first wheel, and the other driving the second, with the desired difference in angular velocity). In order that the second wheel shall at certain times be an "idler," the intermediate gearing can be mounted eccentrically (as the back gear of most lathes), which will permit of its being thrown in and out of gear. If the conditions of the problem were better stated, it would perhaps be possible to arrange a catch so as to release the second wheel automatically. We want to hear further from this correspondent concerning the above doubtful points.

(2636) Concerning Celluloid.—We are aware of the fact that the manufacturers of this singular product endeavor to conceal from the public every detail of the process of its manufacture, on which account it is not to be wondered at that there exists considerable diversity of opinion as to its composition. On this point, however, every doubt may be set aside by consulting the United States patent granted to the inventors of celluloid—the Brothers Hyatt, of Newark, N. J., all of which specifically refer to the treatment of pyroxylin (gun-cotton) with solvents, the chief of which in their processes is gum-camphor. On this point there is no room for doubt, any and all newspaper reports to the contrary notwithstanding. As to the question whether the product is explosive, we think we may safely answer that it is not. That it is highly combustible, our correspondent may satisfy himself by placing it for a moment in contact with a flame. The form of gun-cotton used for conversion into celluloid, it should be noticed, is not the fully nitrated product known as explosive cotton, but rather a species of that intermediate nitrated compound known as soluble (photographer's) cotton. That the process of manufacture is dangerous, cannot be doubted, for the procedure of converting the paper or paper pulp into pyroxylin, the mixture of this with camphor, and the subsequent application of considerable heat to effect its solution, are each hazardous steps; in proof of which the occasional occurrence of serious explosions will testify. The statement that celluloid is made of paper pulp, treated by some chemical process, should of itself convince our correspondent that the writer, whoever he may be, knew nothing of the subject he was writing about, as it is too vague and general to convey any notion of the composition of celluloid. The essential features of the manufacture of this substance, as set forth in our recent article, our correspondent may rely upon as being entirely correct.

(2637) Rules for Pipes and Passage of Gas.—There are so many modifying elements in the problems propounded by E. B. K., that a simple rule, as the term is generally accepted, is out of the question for either case. The motion of gaseous bodies through pipes has been made the subject of careful study under all possible conditions, and the result has been the establishment of formulæ by which the problems occurring in the practice of the gas-works engineer may be solved very accurately; but by reason of the modifying elements of friction, varying specific gravity of gas, varying length of pipe, etc., the calculations are necessarily complicated. We give in the following the formulæ established by Clegg and others covering the questions asked by this inquirer, and explain them by examples showing their application:

Let Q=the quantity of gas passing per hour, in cubic feet.
l=the length of pipe in yards.
d=diameter of pipe in inches.
h=pressure in inches of water.
s=specific gravity of gas (air being equal to 1).

$$\text{Then } Q=1350d^2\sqrt{\frac{hd}{sl}}$$

which, interpreted in the vernacular, means: Multiply the pressure in inches by the diameter of the pipe in inches. Divide the product by the specific gravity of the gas multiplied by the length of the pipe in yards. Extract the square root of the quotient, which root, multiplied by 1350 times the square of the diameter of the pipe in inches, will give the number of cubic feet discharged in one hour. *Example:* It is required to find the number of cubic feet of gas of specific gravity .420 that will be discharged from a pipe 6 inches diameter and 1,760 yards long, under a pressure of half an inch (.5) of water. Now, by the formula $h\times d=6\times .5=3$

$$\sqrt{\frac{h\times d}{s\times l}}=\sqrt{\frac{3}{.420\times 1760}}=\sqrt{.00405}=.063$$

$$1350d^2\sqrt{\frac{h\times d}{s\times l}}=1350\times 36\times .063=3061.8 \text{ cubic feet}$$

—the required answer. To find the diameter of pipe, the foregoing formula will require the following modification:

$$Q=1350d^2\sqrt{\frac{hd}{sl}}, \text{ to find the value of } d.$$

Squaring the equation, we will have

$$Q^2=(1350)^2 d^4\frac{hd}{sl}$$

$$\text{or, } Q^2=\frac{(1350)^2 h}{sl}d^5 \text{ ; therefore,}$$

$$d=\sqrt[5]{\frac{Q^2 sl}{(1350)^2 h}}$$

Which, interpreted, gives the following rule: To find the diameter of pipe, multiply the square of the quantity of gas delivered by the specific gravity of the gas, and this product by the length of pipe; divide this quantity by the square of the constant number 1350, multiplied by the pressure in inches, and extract the fifth root, which will give the diameter of the pipe in inches. The mode of applying the first rule is made so plain in the example given, that an additional one here will not be required.

(2638) Works on Air Compressors.—We refer this inquirer to the following works, in which the subject of air compressors is treated of more or less exhaustively, namely: "Tunneling, Explosive Compounds, and Rock Drills," by Henry S. Drinker. Price $25. In this work rock drills and air compressors are treated. "A Practical Treatise on Mining Machinery, Tools, and other Appliances Used in Mining," by Geo. G. André, F.G.S., London. Price $28. We can furnish either of these works on receipt of price. Besides these two authorities, who discuss the subject very fully, our inquirer will find references to air compressors in "Knight's American Mechanical Dictionary" and "Appleton's Encyclopædia."

(2639) Varnish for Colored Prints, Etc.—The following recipe may answer our correspondent's purpose: Take of Canada balsam 1 ounce; spirits of turpentine, 2 ounces, and mix well together. The print or drawing should first be sized with a solution of isinglass in water, and when this has dried, the varnish above named should be applied with a camel's-hair brush.

THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 7. JULY, 1880. TWELFTH YEAR.

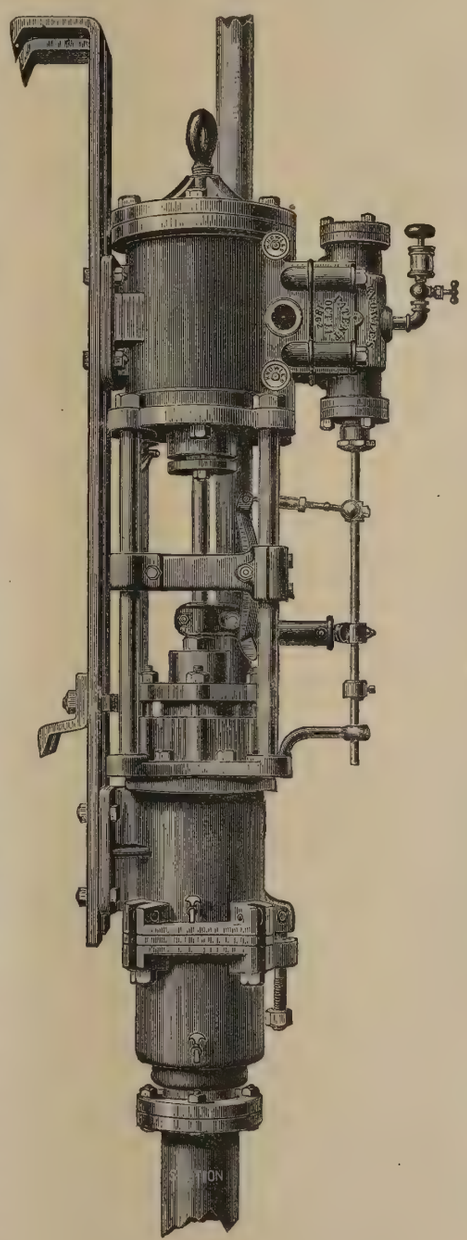
An Improved Mining Pump.

The necessities of the mining interests of this country, which have become so important a factor in our industrial life, have called for the creation of many new mechanical methods and appliances, to meet and overcome the difficulties with which nature jealously protects her hidden treasures from the hand of the universal invader—man. Water is the greatest obstacle that interposes itself, and is often poured forth so lavishly from the subterranean reservoirs, as to compel the abandonment of rich or promising mines; more frequently, pumping machinery may keep the workings clear, and in the rarest instances the mine is dry. Against this ubiquitous enemy, the one rule holds good—that "eternal vigilance is the price of safety."

Our manufacturers have not been slow to recognize the fact that the peculiar requirements of mining work called for pumping machinery devised with special adaptation to the needs of the mining engineer; and our leading pump builders have given the subject their careful study, with the result of producing machines of special form and construction to serve the wants of the miner.

By a glance at the illustration accompanying this article, our mechanical readers will at once recognize one of these special appliances, designed in form and construction for particular service in the field referred to. It is an improved vertical sinking pump, built by the well-known Knowles Steam Pump Works, of New York and Boston. The vertical form and compactness which distinguish the apparatus, are intended to meet the exigencies of water invasion in the sinking of a new shaft, or in recovering a flooded mine, where in many cases the use of the usual horizontal mining pump is rendered extremely inconvenient, if not impracticable, by reason of the difficulty encountered from the frequently confined and awkward situation of the workings, and consequent great loss of time involved in raising and elevating the pump from one level to another, and rigging it in proper position for work. In many cases of this kind, where the necessities of the case are supremely urgent and every minute of time is precious, a pump that has been conveniently designed to meet just such cases, that may be quickly handled, put in position, and started to work with the least possible sacrifice of time, may be worth its weight in gold.

Our engraving so clearly shows the special features of this machine that an extended description will be unnecessary, we therefore simply indicate its salient points. To enable the machine to be conveniently lowered into a shaft and moved from one level to the other, the vertical form is specially useful by reason of the generally narrow and confined character of the situation. This construction is, therefore, best adapted by reason of its superior compactness, for work in a situation where every foot of room is wanted. A strong ring-bolt is imbedded in the heavy steam cylinder head, for the attachment of the necessary tackle for quickly raising and lowering the pump to follow the fluctuations of the water level, and bolted to brackets on the side of the pump are seen a pair of wrought-iron dogs for gripping the timbering of the shaft, to steady the pump while at work. The pump is of the bucket-plunger pattern, which is believed to be best suited for gritty and bad mine water generally. The pump-barrel in which the bucket works is of gun-metal, and is made an independent casting, so that when worn out in service, it may be removed and a new barrel substituted for the old one. By swinging-bolts, that are provided for the purpose, the interior of the pump-barrel and water-valves are made accessible for inspection and repairs. Hose or pipe connections to the pump may be made, according to convenience.



Improved Vertical Sinking Pump.

The apparatus here illustrated is said to be the next to the smallest of the several sizes built. It has a capacity of about 80 gallons per minute, and weighs about 1,000 pounds. The claim is made for it that it will throw a steady and continuous stream of water from any point in the shaft, and that it will work in any position in which it is placed.

From our description, the adaptability of this machine for the special work for which it is designed, will have been made apparent.

Elevated Railroads in Philadelphia.

The Pennsylvania Railroad Company is proceeding vigorously with the work of building their elevated railway along Filbert street in that city, from the Schuylkill river to the projected terminus at Market and 15th and 16th streets. The foundations for the piers of the new bridge are already down on the bed of the river, the houses along the line are already demolished, and the work of erecting the bridge and permanent way will be finished some time during the summer.

A project for an elevated passenger road, similar to those in this city, is also being mooted, and the Councils of Philadelphia will be strongly urged to grant the necessary franchises to its projectors. This scheme involves an elevated road through Market street, the main business avenue of Philadelphia, from the western extremity of the city, crossing the Schuylkill by a new bridge to be erected, and terminating at the Delaware or eastern extremity, from which point, as well as elsewhere along the line, lateral branches, running north and south, are projected. The scheme is now being actively discussed, but arouses so much opposition that it is doubtful if the company will be able to secure the necessary privileges from the municipal authorities.

Glass Types.

The usefulness of toughened glass, says the London *Pottery Gazette*, bids fair to be greater than was at first supposed. Some experiments are reported to have been made in France with a view to showing whether this substance can be pressed into the printer's service and substituted for the metal composition of which types are made. The latter does not at first sight strike the observer as the best that could be found. It is bright enough when the letters first come from the foundry, and before they have seen any service; but a few days' wear gives the type a very dingy appearance, and before they are finally returned to the melting-pot they have degenerated into a very squalid form, looking dirty in their body as well as battered in their faces. The idea is now to discard these long-proved but unattractive servants, and fill their places with glittering types of glass. The advantages in point of cleanliness alone would, it is alleged, be not insignificant. The toughened glass, which is not to be made in quite the same way as that used for tumblers and wine-glasses, and need not, of course, be quite so transparent, is naturally much harder than the old metal, and can hardly be crushed out of shape by those little accidents which so shorten the life and spoil the beauty of the only type we now employ. It is also capable of being cast into more delicate shapes, so that the difference, for instance, between the thin and the thick strokes can be more clearly defined. Finally, it is now found that the new material can be cast in exactly the same molds as the old, and that therefore there need be no expense incurred in altering the machines and implements used in the manufacture of type.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

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The Business Outlook.

To the disturbing influence of the recent great decline in inflated values which attended the collapse of the recent boom, several additional disquieting elements have developed into prominence and subsided since our last issue. We refer to the failure of the Philadelphia & Reading Railroad Company, and the threatened strike of the Pittsburgh puddlers. The failure of the Reading company, however, was not entirely unexpected, and its effects therefore were neither wide-spread nor permanent; and the trouble with the iron-workers, which threatened at one time to close all the mills in Pennsylvania, has happily been averted by unexpected concessions on the part of the manufacturers. As the weeks pass by, they show more and more clearly the utter folly of such senseless speculation as we have left behind us. To force things, and discount the future, may do for Wall street, but not for the general business of the country.

We look upon the condition of things to-day, however, as being better than they were last fall, for while all the substantial causes and evidences of a sound prosperity are ours now, in an even greater measure than then, the recent check to reckless speculation will have, at least for the immediate future, a healthy effect.

In the iron trade, which gives the key-note to the general condition of business, the remedy for the late collapse has been discovered, and is being manfully applied, and when a few months shall have cleaned out the stocks of foreign products that have flooded our markets, we shall almost certainly see a revival of a substantial and permanent nature.

In general business, the testimony has been so uniformly satisfactory as to demonstrate a prevalent opinion that the troubles of our leading industries are but temporary, and that the country at large is too prosperous to experience a permanent set-back. That this opinion will be justified in the fall, we have every confidence.

The Farce of Steamboat Inspection.

In a somewhat cynical vein, one of the daily papers, in discussing the circumstances attending the recent disastrous collision of two Sound steamboats, draws the inference that while the steamboat men, on the whole, would rather not have their boats destroyed, they nevertheless act on the conviction that in case of a disaster, the passengers ought to go down with the boat.

This very disquieting assertion, the journal in question proceeds to prove by a severe criticism of the utterly inadequate condition of the life-saving appliances—meaning the life-preservers and boats—on board the colliding vessels. The former were stowed away in such a manner that it was necessary to have them distributed, by some one who knew how to get at them, when they were wanted; but when a few of the unfortunates were unfortunate enough to secure possession of one of them, they were found, in strict accordance with the theory of our daily contemporary, to be provided with straps that were rotten.

But what of the life-boats, with which the law's wise foresight demands every passenger vessel shall be provided? We are loath to put the fact on record, but here again the theory of our cynical contemporary is verified by the state of things that was found to exist on the *Narragansett*. The steamboat was built two or three stories high, and the life-boats, which were entirely inadequate, were placed in such a position that the inflammable upper works of the vessel, which it was necessary to mount or approach to launch them, were aflame before some of them could be got at, which was probably a providential circumstance, as it was ascertained afterwards that the plugs with which the life-boats (?) are for some unknown reason provided, were carefully left out—and so forth, to the end of the calamitous chapter, which has doubtless furnished the text for more than one sermon on the mysterious dispensations of Providence. From all of which, our neighbor affirms the plausibility of his theory that steamboat men hold it to be the duty of passengers—but not of the captain—to sink with the boat.

To come down from cynicism to stern, sober fact, it does seem, in the light of the terrifying and simply horrible sacrifice of human life in this last collision on the Sound, like an insult to common sense to affirm that the inspection laws governing the conduct of passenger vessels are at all adequate to afford reasonable protection to their living freight in the event of accidents that are constantly liable to happen. The steamboat on which such lamentable loss of life occurred, doubtless carried the full complement of life-preservers and boats prescribed by law; and the utterly disgraceful inefficiency of her life-saving paraphernalia when the supreme moment arrived to test its utility, offers a conspicuous proof of the imperative necessity of so modifying legislation on this all-important subject that inspection shall be something more than what it proved to be in this, and what it doubtless is in numberless other cases—a farce.

Thus far we have said nothing of one vital point in the consideration of the Sound disaster, namely, the cause of the collision, and on this, our opinion is decided that the accident was entirely inexcusable, and could have been avoided had the owners and officers of these boats used such proper and reasonable precautions as it was in their power, and as it was their imperative duty to use, for the protection of the lives of their passengers. It has since appeared that in the trips of these steamers, no law of the road is observed—that any part of the channel that happens to be most convenient, is chosen by boats going and coming, and in all kinds of weather; and, worst of all, the colliding boats were going ahead at full speed, as appears to be the custom, in a dense fog, without the use of any other precaution against collision than a paltry signal lantern or two, that could not be seen the distance of the boat, and the sounding of the fog whistle, —a notoriously deceptive safeguard.

Under such circumstances, which appear to be everyday occurrences on the boats that ply the Sound, it is not surprising that the officers of other boats should hasten to the support of the captains of the colliding vessels by asserting that the accident was unavoidable. Unavoidable, indeed! We do not think it possible to exhibit another case in which greater recklessness and indifference to the safety of life could be shown than in this one, and, in the light of the facts, the plea of "unavoidable" would be ridiculous, did not the events of the late terrible accident invest the subject with too much solemnity to warrant such characterization.

With all the reckless disregard of everything but to get to their respective destinations on time, the collision of the Sound boats, and that of the two ocean steamers that occurred a few days later, could in all probability have been avoided had the vessels in question been provided with electric signal lights in place of the utterly inadequate oil lanterns they were provided with. The futility of trusting to these, and to fog bells or whistles, to avoid collisions, has been again and again demonstrated, while the power of the electric light to penetrate a fog has been shown to be infinitely superior to any form of light yet devised, and its efficacy as a safeguard against this class of accidents is out of all comparison superior to anything else. The use of electric signal lights should, therefore be made mandatory on all steam vessels, and an end would be had of such lamentable occurrences as that of which we have been writing.

Collisions, however, do not comprise all the mishaps that sea-going vessels are liable to meet with, and compliance with this one efficient safeguard will not palliate such reckless and inefficient management and provision as are comprised in the offenses charged to these Sound steamers. In the event of other forms of accident, there would be no protection for the passenger against a "land-lubber" crew, whose knowledge of seamanship is limited to their ability to swab the decks; against rotten life-preservers stowed away in mysterious receptacles, or carefully out of reach; against

unserviceable or inaccessible life-boats, unprovided with oars or thole-pins, or, on the other hand, provided with holes from which the plugs are carefully left out. These, and other deficiencies, demand radical remedies that sensible legislation, reinforced by the most rigid and careful inspection, only can give us.

American Enterprise in Russia.

Two or three weeks ago, a distinguished company of mining engineers and metallurgists, under the leadership of Mr. Wharton Barker, a leading banker, left New York in the *Scythia*, their ultimate destination being Southern Russia, and the object of their pilgrimage to start a great American project for the development of the resources of that country. The inside history of this expedition is interesting. The Russian government, it appears, has long been anxious to open up and reap the benefits to be derived from the development of the great iron and coal fields known to exist in that portion of their territory which borders on the Sea of Azof. The satisfactory manner in which American enterprise had, under Winans and Harrison, created the railroad systems of Russia, and the knowledge also that the coal and iron industries have reached a high state of perfection in this country, were probably the inciting causes that induced the Russian authorities to offer to confide this highly important work to American hands.

Mr. Wharton Barker, a well-known banker of Philadelphia, who acted as the agent of the Russian government several years ago in the construction of several war vessels at the Philadelphia ship-yards, was selected as the proper person to whom a work of such importance could be confided; and accordingly we are informed that the Czar, on the occasion of a visit by Mr. Barker to Russia about a year ago, tendered to him a concession which includes the sole right of opening up the Donetz coal fields north of the Sea of Azof; the iron deposits of Krivoi Rog, north of Crimea; the construction of a railway system for the proper development of the foregoing; the establishment of a great shipping port on the Sea of Azof; the erection of a Bessemer establishment; the building of grain elevators, etc.

The time of this important concession is stated to extend to eighty years—certainly a very liberal allowance. Mr. Barker at once laid the matter before some of the leading capitalists of New York and Pennsylvania, with the result of the sending out of a corps of engineers to make a thorough geological survey of the region. These experts were under the direction of Mr. Henry A. Vezin, and their report, lately made, was so satisfactory, that a number of the capitalists named agreed to furnish the capital necessary for the undertaking of the work, which is estimated to be not less than $8,000,000.

The expedition which has just set out under Mr. Barker's direction, comprises in its make-up, Mr. John Fritz, of the Bethlehem Iron Co.; Charles S. Hinchman, of the Pennsylvania Iron and Steel Co.; and S. T. Fuller, of the P. W. & B. Railroad Co. These gentlemen will inspect and report upon the character and quality of the coal and iron ores, the fitness of the country for railroad purposes, and other matters affecting the commercial aspects of the enterprise. Should their reports to the stockholders be satisfactory, the work will be at once undertaken and pushed forward.

Newspaper Enterprise—A New Use for the Telephone.

We record with interest the fact that the London *Times*, with a proper appreciation of the utility of this instrument for its requirements in the speedy collection and reception of news, has placed its composition-room in telephonic communication with the House of Commons, and is thus enabled to put in type with greater dispatch the debates and proceedings of that body, and frequently to publish accounts of such proceedings half an hour or three-quarters of an hour later than had hitherto been possible.

The reporter stationed in a room adjoining the reporters in the House gallery, reads from his notes directly into the instrument, sentence by sentence, and the compositor, with his type-setting machine at the *Times* office, sets up the matter as it is read, signaling the reporter when he has set up one sentence and is ready for the next. A simple code of pre-arranged bell signals suffices for intelligent communication between sender and receiver. The plan is reported by the *Times* to work very well.

The Perkins High-Pressure System.

AN IMPORTANT DEVELOPMENT OF THE COMPOUND ENGINE.

The arrival of the little steamer "Anthracite" at St. Johns, N. F., eighteen days out from London, is an event of special interest to the engineering fraternity. The steamer in question embodies in the construction of her engines, some advanced ideas which have been advocated by Mr. Loftus Perkins, and the trial trip of the miniature vessel seems to have afforded the data for the triumphant confirmation of the claims of her designer, and to have demonstrated a decided economy in the use of steam power.

The essential features of the Perkins system are simply an extension of the governing principle of the present compound engine, in the direction of using steam at very high pressures, and with still greater expansion. Mr. Perkins, in developing the system with which his name is associated, appears to have reasoned that if a (comparatively speaking) high economy is attained by the use of steam, of moderate initial pressure expansively, with the employment of compound engines, why not carry the same principle further? It requires but a small increment of heat to raise the steam pressure from 75 or 100 pounds, which is that ordinarily employed, to 500 pounds, or higher; and this accomplished, the engineer has at command an enormously greater power. That there would be decided economy in using steam at higher pressures than is generally employed, and expanding it more, is universally admitted; but the difficulties that lay in the way of practically applying the principle were of a serious nature. The most important of these are, first, the liability to disastrous explosion of the steam boiler under such enormous strains as would be brought upon it by carrying such high steam pressure as 500 pounds, and which, should it occur, would suffice to rend the stoutest ocean steamer to pieces; and second, the difficulty of lubricating the pistons and glands of the engine, by reason of the high temperature of the steam. These difficulties Mr. Perkins set himself to work to master, and has succeeded.

The first difficulty he has met by constructing his boilers on the tubulous principle, and in a manner which combines maximum strength with safety, while their durability was insured by using nothing but fresh water, or distilled fresh water, over and over again. The second difficulty he has overcome by introducing the high-pressure steam into the upper end of the first cylinder, where there is no gland, and where the piston is so formed as to require no lubrication. The steam is cut off at about half-stroke in this cylinder, and when it is admitted for the return stroke into the bottom of the second cylinder, of four times the area of the first, its temperature is so much reduced as to cause no difficulty when brought into contact with the piston rod gland. From the bottom of the second cylinder the steam expands into the top of the same, which is of larger capacity than the bottom, and serves as a chamber, and is in direct communication with (a peculiar feature of the Perkins system) a third cylinder of four times the capacity of the second, where the final effect of the expansion of the steam is obtained, and from which it exhausts into the condenser after a total expansion of 32 times. To prevent the scaring and cutting of the cylinders, piston rings of a special compound metal were adopted, requiring no lubrication, and with excellent results.

To recapitulate, then, the Perkins system consists of a tubulous boiler, in which steam is generated at very high pressure, and a special form of engine, in which the steam is used and re-used over and over again, the boilers being supplied with distilled fresh water, of which a small surplus supply is carried, to make up for losses by waste and leakage, which involves no serious inconvenience. The advantages claimed for, and which, as we shall presently see, have been attained by this system of construction, are, a very high economy in the consumption of fuel and immunity from explosion.

The boiler is composed of a series of horizontal tubes, welded up at each end, and connected by small vertical tubes which are screwed and calked into both ends of the horizontal tubes, the whole having been tested by hydraulic pressure to a testing strain of 2,500 pounds per square inch. The engine has three cylinders of unequal diameters, the pistons of the first and second being single-acting, and bolted together in the same straight line and having a common piston-rod; and the third, double-acting, with its piston-rod connected to a crank at right angles with the other crank.

Provided with engines on this plan, the miniature steamer "Anthracite" has just successfully accomplished the Atlantic passage. Her dimensions are as follows: Length, 84 feet; breadth of beam, 16 feet; depth, 10; engine and boiler room, 21½ feet long; gross tonnage, 70.26 tons; registered tonnage, 27.91 tons. Her engines have three cylinders, 8, 16 and 23 inches diameter respectively, with 15-inch stroke. The engines are of 20 horse-power nominal, and 168 horse-power indicated.

The boiler was tested to 2,500 pounds pressure when built up complete, each tube having been previously tested to 4,000 pounds. The condenser is so constructed that no admixture can take place between the distilled fresh water used in the boiler and the salt water employed for condensing. A tank holding 280 gallons of fresh water, placed in the engine room, makes good any waste by leakage or otherwise, and this water also is distilled before it is admitted to the boiler.

With these paraphernalia, the little vessel made the Atlantic passage from London (*via* Falmouth) to St. Johns, N. F., arriving at her destination in 18 days, experiencing unusually boisterous weather throughout the entire passage. The success of the experiment will be appreciated by our engineer readers, when it is stated that the "Anthracite," with a boiler pressure of from 350 to 500 pounds, made the Atlantic passage on 20 tons of coal, or about 1 pound of coal per hour per horse-power. In an earlier trial trip, this same vessel made a run of 46 miles with 350 pounds boiler pressure, and with an average of 132 revolutions per minute, at an average speed of 8 knots per hour, and with the same economy in consumption of fuel as that above named. The value of this experiment will appear more prominently when it is stated that only 25 years ago our ocean steamships carried about 16 pounds pressure, and consumed 5 to 6 pounds of coal per hour per horse-power, and that our best steamers to-day carry about 75 pounds pressure and require 2½ to 3 pounds of coal per hour to the horse-power.

There seems to be no reasonable room to doubt that Mr. Perkins has realized in practice a very decided advance in steam engine economy, by boldly carrying into execution a radical modification of the present system of engine construction, in the direction toward which the tendency of modern engineering has been drifting, and the undoubted success which he has achieved, it is almost safe to predict, will compel the adoption of his system in the future construction of marine engines.

The reduction of coal consumption on our ocean steamers from 2½ or 3 tons per hour per horse-power to 1 ton, which means a saving of nearly or quite two-thirds in the cost of making the ocean passage, and the saving of a considerable space for paying freight, is a great achievement. We are slowly improving the duty of our steam motors, and a few more such radical advances as that of Mr Perkins will materially lessen the gap between theory and practice.

Carr's Brass Double-Action Pumps.

There is probably no single instrument upon which a greater amount of ingenuity has been expended by our mechanics, than upon the single item of pumps. From the simple single-acting hand-pump to the great compound-pumping engine is a very long stride; but the intervals are so well filled out by the almost infinite variety of intermediate forms of apparatus, adapted with marvelous exercise of mechanical skill and ingenuity to every conceivable want of the household, the farm, the factory, the mill, the town, and the city, that there is no "missing link" in the history of this genus, at least. The explanation of the multiplicity and diversity of forms and construction exhibited by this instrument, are amply explained on the simple ground of its absolutely indispensable character, a distinction which it only shares with the means and appliances for giving light.

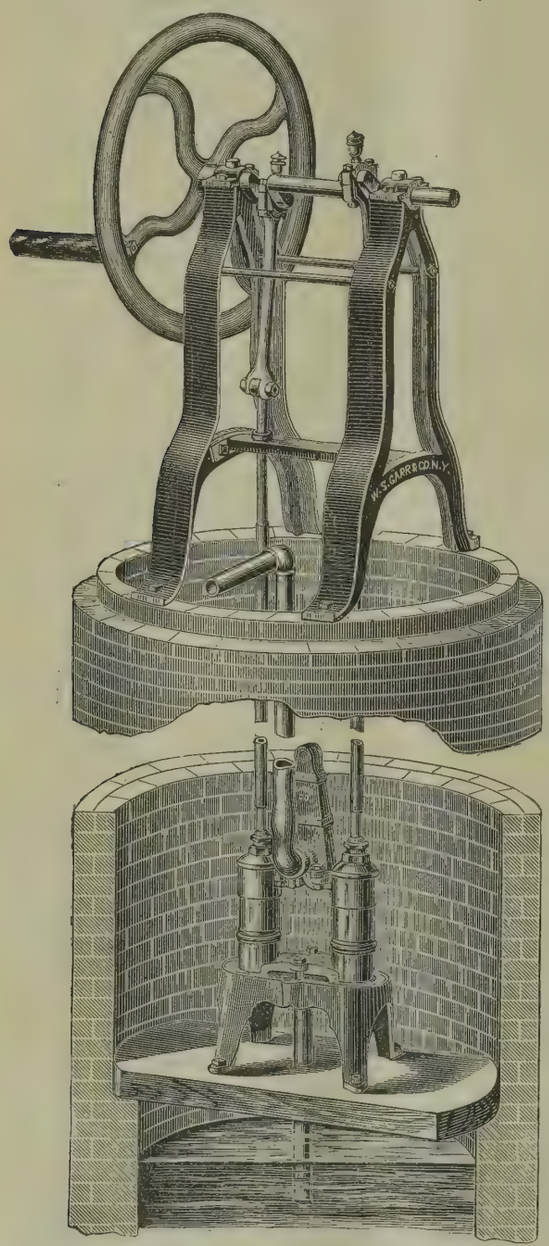


Fig. 1.—Double-Action Pump, with Frame and Wheel, for Deep Wells.

We give in the accompanying engravings, illustrations of several standard forms of pumps manufactured by William S. Carr & Co., 106–110 Center street, New York, (factory at Mott Haven, N. Y.) These pumps enjoy a well-earned reputation for elegance and simplicity of design, compactness, efficiency and durability.

Fig. 1 represents a double-acting pump, with hand-wheel and frame, mounted to show its adaptation for deep-well pumping.

Fig. 2 shows a horizontal form—the so-called double-action Monitor pump, bolted to a bracket, and operated by means of the crank and hand-wheel shown. This form of pump, it will be observed, may be attached against a wall or partition, and, in many situations in the house, store or mill where floor space is valuable, will be found very convenient and serviceable.

Fig. 4 shows the so-called Bunker Hill pump, a double-action pump of different form, operated by means of the rocking-beam and hand-lever.

Figs. 3 and 5 show other modifications of the double-acting horizontal or Monitor pattern, suitably mounted on framing, and provided with the air-chamber of conventional form.

The operation of these several devices will be sufficiently obvious to our mechanical readers to render further description unnecessary.

The forms of pumps here illustrated are only a few of the great variety manufactured by the firm above named, from whom an illustrated sheet, comprising the numerous styles of their production, will be sent on application, as well as any special information that may be desired.

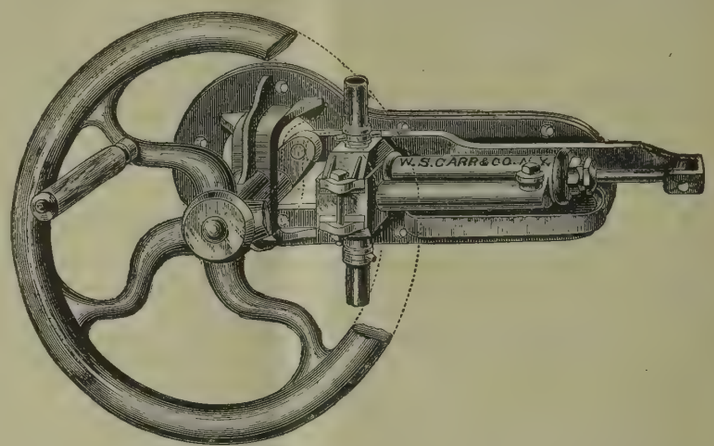


Fig. 2.—Double-Action Monitor Pump, with Wheel, on Bracket.

Benefits of Good Tools.

There is an old saying to the effect that "it takes a good workman to make a good job with poor tools." So it does; and there have been many triumphs, recorded and unrecorded, of brain and skill over seemingly insurmountable obstacles. It is a satisfaction to compass a result with apparently inadequate means, and the mechanic who does it is justly proud of his success. But working with poor tools is never certain to produce good results, however great the skill and inventive the brain. Misses are are made as well as hits, and even the most self-assured workman feels safer with good and applicable tools. No workman can afford to risk his reputation and success with poor tools; there is so much risk of a failure and such anxiety for the result, that even if success is attained, it has been at the expense of time, thought, muscle and trouble that robs it of half its gratification.

The time has gone by when the workman was expected to "make something out of nothing;" when one implement or appliance was made to do duty for another, and "make-shifts," their origination, use and application to the job in hand were part of the kit of the workman. The constant and growing improvements in tools and labor-saving machinery has not only increased the profits of the manufacturer, but lightened the labors of the workman. The machinist who learned his trade thirty years ago, would now be ashamed to resort to the wretched substitutes of tools with which he was then compelled to do his work. The carpenter knows the value of the mortising machine, the molding machine, the band saw and other improvements. The blacksmith sees the advantage of the drop-hammer, the shearer, the steam-hammer and the portable forge; and even the farmer, who keeps up with the times, appreciates the mowing machine and the many improved hand-tools which facilitate his operations and reduce his labor. There may have been brain energy and labor wasted in the production of improved tools and appliances, for there are some which have never met the expectations of their contrivers or filled the wants of the users. But, in truth, there has been no portion or department of mechanical endeavor that has accomplished better results or reached higher success. The number of special tools now used is wonderfully great as compared with thirty years ago. There is no manufacture of consequence

Fig. 3.—Monitor, on Frame, with Fly-Wheel.

that has not its special appliances, machinery and tools, and in tools for general work the improvement has been fully as marked. Even in hand-tools the improvement is obvious to the slightest observer. In every department of industry these improvements have made their mark. They save time and labor, and produce more satisfactory results. It is a wise economy to reject imperfect tools, and, as the patent-medicine men advertise, "use the best." Whenever an improved implement is put into the market—one that will do the work better or quicker—it is economy to buy it, even if the old one is intact and serviceable.

Recent Telephone Experiments.

Some experiments are reported to have been lately made in this city, to determine approximately through how many united circuits and lines the voice of a public speaker might be simultaneously transmitted. To this end, telegraphic communication was made by means of the wires of the Bell Telephone Company and those of the Gold and Stock Company, with the auditorium of Mr. Beecher's church in Brooklyn. The electrical circuit thus established ramified in all directions, communicating with offices and dwellings in New York, Brooklyn, Jersey City, Newark, Orange, Elizabeth, Yonkers and other adjacent places.

The first trial did not result very satisfactorily, as certain parties, who had learned of what was going on, had surreptitiously tapped the wire leading from the church. A second trial was made a week later, and is pronounced to have been remarkably successful. Special care was taken not to allow of so many tapping instruments in circuit, and the transmitting instruments at the church were adjusted with the utmost delicacy. The report of this second trial we extract verbally from the *Scientific American*, since the experiments demonstrate beyond doubt that the use of the telephone is capable of almost indefinite extension. Our contemporary affirms that "from the opening note of the organ prelude to the last word of the preacher's voice at the close of the service, everything was delivered to the ears of the listening telephoners in the most perfect manner, the tones that came over the wires being so full, round, clear and distinct, it seemed almost to the hearers in New York, Yonkers and Elizabeth as if they were stationed within the church itself directly in front of the speaker. The delivery of the music was equally perfect, every note of the organ, and of the individuals of the choir, being fully brought out. The majority of the participants in this experiment were persons accustomed to the use of the telephone, and their unanimous verdict was that the results obtained far surpassed anything of the kind within their experience."

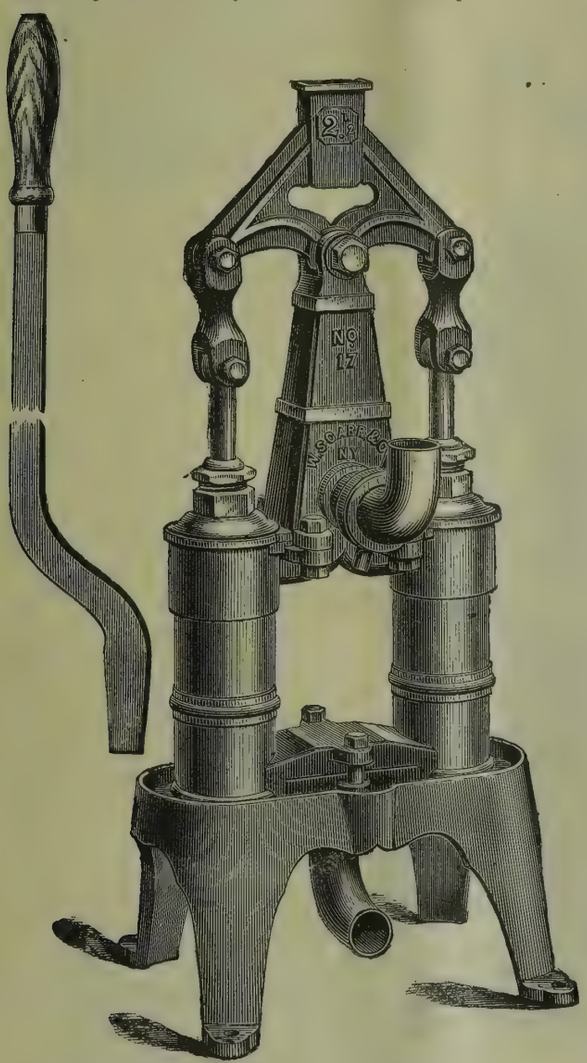


Fig. 4.—Double-Action "Bunker Hill" Pump.

Use of Glass for Construction.

The use of glass as a material for construction is attracting attention in England since the practical application of toughened glass to permanent ways has been successfully made. Mr. Bucknell, an English engineer, it is reported, proposes to manufacture pipes for gas and water conduits, for drains and chemical purposes, as well as building blocks and numerous other articles.

In a late paper read before the Society of Arts of London, an interesting account was given of the remarkable results of the strength of samples of toughened glass; and it was asserted that old as the manufacture of glass is, the various processes of toughening it are still in their infancy, and that it is not unreasonable to look for immense improvements in this direction in the future.

Respecting the manufacture of the toughened glass sleepers, which have attracted so much attention by reason of the novelty of the application, it is stated that the clamps and other metallic attachments, are put in red hot while the glass is still fluid, and that when cold the glass and iron hold rigidly together. There is little to be feared of the cracking of such a joint, as the mutual expansibility of glass and iron differs very little. The cost of this toughened glass is, weight for weight, about the same as cast iron; but as the glass is only about one-third as heavy as the iron, it is evident that for equal dimensions the cost of the glass will be only about one-third that of iron, the ton of glass making three times as many sleepers as the ton of iron, supposing it to be so applied.

Concerning Petroleum.—Mr. C. A. Ashburner is authority for the statement that since the discovery of petroleum by Colonel Drake, in 1859, Pennsylvania had produced, up to the end of 1879, not less than 133,262,639 barrels of crude oil, valued at $340,709,672. His theory of the origin of the oil, is that the oil sands are the mere reservoirs which contain the product of the decomposition of vegetable and animal life of the Devonian epoch.

Manufacture of Paper Barrels.

The American Paper Barrel Company, of Hartford, Conn., make barrels, kegs and cans from paper pulp, which is done wholly by pressure by screw or toggle-joint, or both combined. The barrel is made on a shape or form to make the inside, and outside of this is another to make the outside, the inner form being hinged in sections to admit of its folding on itself for the removal of the barrel. The outer form contracts by the action of screws (self-operating) during the process of shaping the barrels. One machine is capable of producing 200 barrels per day. The heads of the barrels are produced by similar means, but on a much simpler machine. These are disks with a rim slightly projecting on one face. In some cases both heads are cemented in, and straightened by an iron hoop at each end. When removed from the machines, the barrels, kegs, heads, etc., are placed in a kiln or drying-room, where they remain from three to twenty-four hours, according to size and the degree of heat admitted to the room. The barrels are coated inside when required, by a resistant varnish, and are painted or varnished outside. They are adapted for flour, sugar and any dry substances, for kerosene, lard or any liquid, and kegs are made for powder, and cans for other materials. These vessels are said to be practically indestructible, cannot leak, are light, and easily handled,

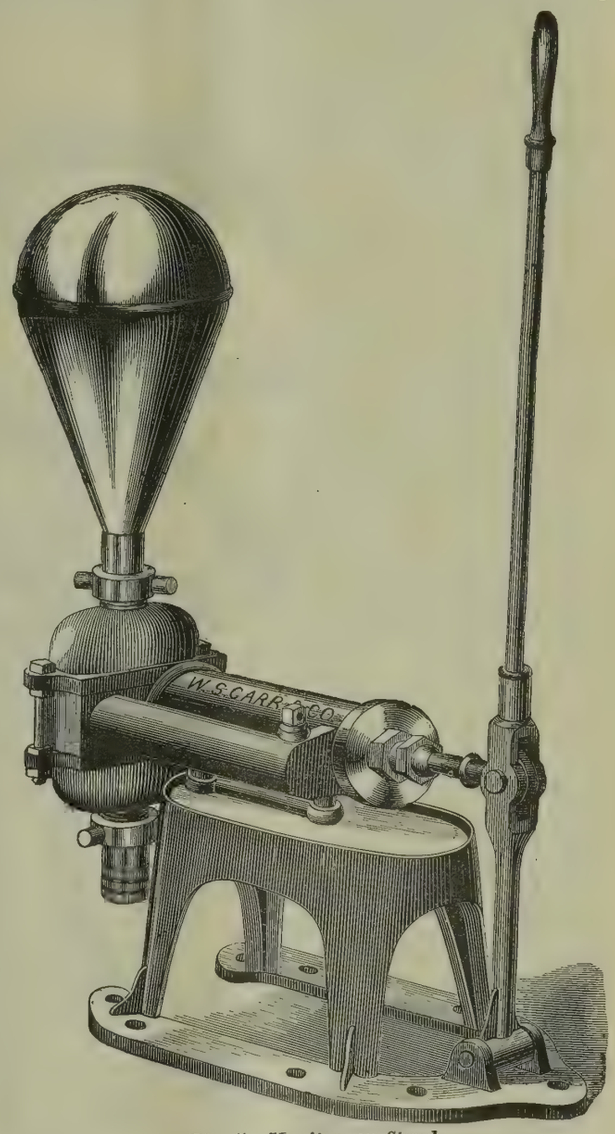


Fig. 5.—Monitor, on Stand.

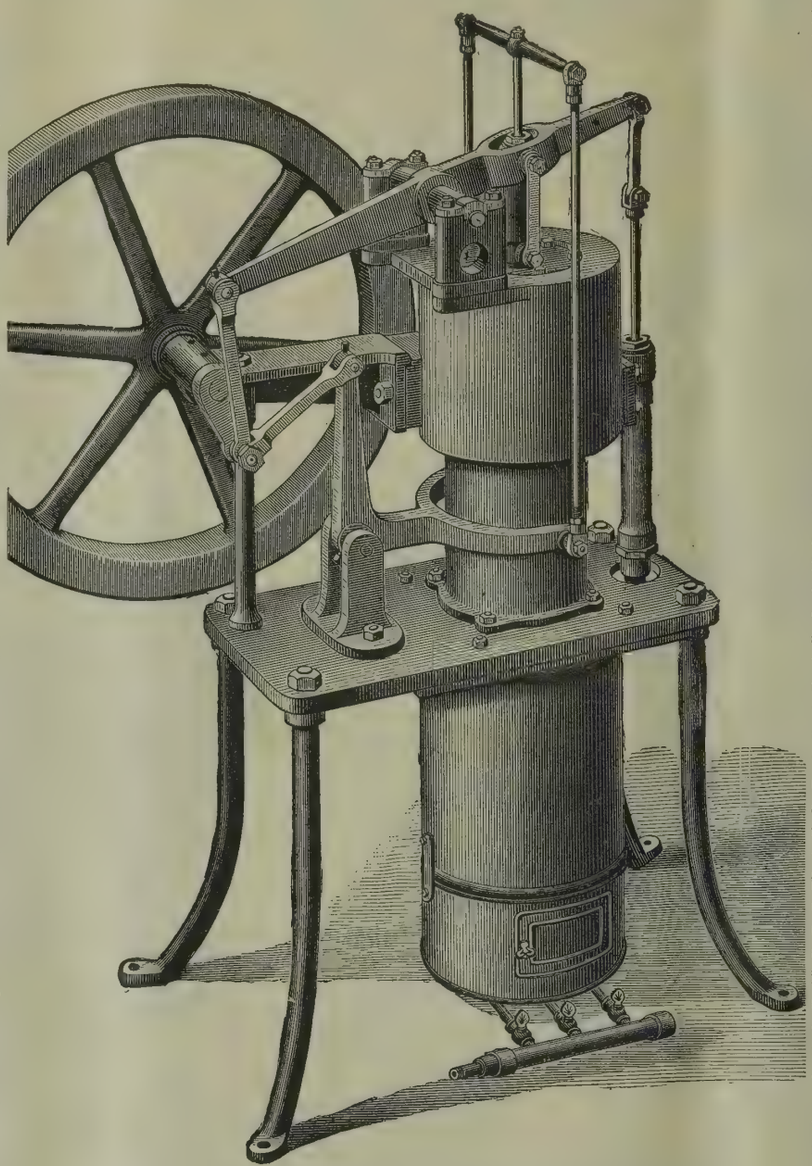
Ericsson's New Caloric Pumping Engine.

Capt. Ericsson's name is so closely identified with some of the most original and remarkable mechanical inventions of our times, that any invention with which his name is associated may be assumed with safety to possess decided merits.

The veteran engineer has at length turned back from his work upon the problem of the "solar engine," to bring out a most excellent and simple caloric engine for domestic purposes, which, so far as we may judge from the examination we have been able to give it, leaves little to be desired on the score of economy, simplicity, and general adaptability for its intended uses. These engines, a general view of which is shown in the accompanying engraving, are manufactured by C. H. Delamater & Co., of 10 Cortlandt street, this city, where they may be inspected and seen in operation.

We invite the attention of our readers to the following description, from which a fair estimate of the merits of the invention will be obtained: The action of this ingenious motor depends upon the rapidly alternating expansion and contraction of a body of air confined within a cylinder, and subjected to correspondingly rapid alternations of high and low temperatures. The details of construction by which the principle here involved is realized in practice, will appear from the following description, reference being had to the subjoined engraving:

The apparatus consists of a long cylinder, supported in a vertical position upon a metallic stand, and having at its lower end a fire chamber, where the heat is supplied either by a set of gas jets (generally three burners, consuming 15 feet per hour) or by a coal fire. The cylinder referred to is closed at the bottom and open at the top. Into the upper end is fitted a piston, working air-tight, and through the piston-rod works the rod of a loosely-fitting plunger, the office of which will appear further on. The upper third of the cylinder, corresponding to the distance the piston travels, is surrounded by a water-jacket, which is supplied with a constant stream of cold water from the pump seen on the right. The office of this device is to rob the expanded air of its superfluous heat after it has performed its work of lifting the piston, and by the resulting contraction that follows, to cause the descent of the piston by atmospheric pressure, which acts upon its upper surface.



ERICSSON'S NEW CALORIC PUMPING ENGINE.

The mechanical accompaniments of the motor will be easily understood from the engraving. The piston is connected by a pair of links to the walking-beam, and the beam is connected to the piston-rod of the feed-pump at one extremity, and at the other is coupled by a connecting-rod to the crank, and by the interposition of a bell-crank and connecting-rods, to the rod of the plunger. The connections of these parts are such as to cause the piston and the plunger to move in opposite directions, and to insure their proper movements with relation to each other.

Having now described the construction of this motor, let us examine its operation. The effect of the heat applied in the fire-chamber upon the air confined in the cylinder, will be to expand it, and to raise the piston with a force dependent on the degree of the expansion. When the piston has reached the end of its upward stroke, the return stroke is made by atmospheric pressure, called into play in the following manner: In the preceding description we pointed out that the upper third of the cylinder, corresponding to the section through which the piston moves, is surrounded by a water-jacket, kept at normal temperature by constant renewal of its contents by the feed-pump. As the piston quickly rises under the action of the expansion of the heated air body beneath it, it exposes the heated air that follows the piston on its up stroke, to the influence of its cooling surface. But with the imprisoned air still in direct contact with the highly heated bottom of the cylinder, this alone would not suffice to promptly reduce its temperature. What is required, is obviously that so soon as the piston has reached the end of its up stroke, the air beneath it shall be cooled and caused to contract suddenly, certainly and regularly, so that by reason of the partial vacuum thus created, the action of atmospheric pressure on the exposed upper surface of the piston shall make the return stroke. That this action shall be made with the necessary promptness and uniformity, it is apparent that the heated and expanded air must, for the instant required for cooling, be withdrawn from direct contact with the highly heated bottom of the cylinder. And here the utility of the above-mentioned plunger comes into play. This plunger, which is loosely-fitting, and therefore not in contact with the cylinder walls, derives its motion from the walking-beam, through the intervention of the connecting-rod, bell-crank and rods, and is so connected relatively to the piston-rod, within which its own rod works air-tight, that its motion alternates with that of the piston—that is to say, the plunger rises as the piston falls, and *vice versa*. When the piston is at the end of its up stroke, the plunger is at the bottom of its stroke, and interposes the obstacle of its solid body between the expanded air and the highly heated bottom of the cylinder. Thus shielded from contact with the heated base of the cylinder, and exposed now for the instant only to the cooling influence of the water-jacket, the air body contracts as suddenly as it had previously expanded. The atmospheric pressure exerted on the top of the piston, promptly causes the descent of the piston, and the return stroke is made. The piston, therefore, only plays in the upper third of the cylinder, and when at the bottom of its stroke, rests on an elastic cushion of air, which occupies the lower two-thirds of the cylinder. The plunger, on the return stroke, is raised by the connecting mechanism, and, displacing the air about it on its upward course, brings the air again in contact with the heating surface, when its immediate expansion again lifts the piston, and so on.

It will be observed from this description that there is no escape of air from the engine, the same charge of air receiving the heat, converting it partly into motion, and, deprived of its surplus heat by artificial cooling, again heated, and so on indefinitely. We have, therefore, in this motor a caloric engine without valves or their equivalents, without air-pump, or air-pump cylinder, and, in fact, with nothing but the plain cylinder with alternating piston and displacing plunger, and the necessary levers to give these simple working devices their necessary relative motions. The action of the motor is kept smooth and uniform by the momentum of the heavy balance wheel, and it works regularly and noiselessly, without requiring any attention after it is once put in motion. The amount of heating of the water circulating in the cooling jacket is said to be so insignificant as to be inappreciable. This fact is made probable by two considerations; first, from the fact that the air is not heated above 400° Fah., and second, that the body of air to be cooled is very small, compared with the extent and specific heat capacity of the cooling surface.

The mechanical ingenuity displayed in the construction of this motor, is in every way worthy of its distinguished inventor, and there is no question but that it will find its way into very extensive use for the purpose for which it has been mainly designed—namely, for pumping water for domestic purposes. As to its duty, we present the following facts, which are vouched for by its manufacturers: The work of this little engine, not more than 4 feet high, table and all, and occupying a floor space of 39 by 18 inches, has been accurately measured by experiment in the houses of Mr. Delamater, of the Delamater Iron Works, and of Mr. Baldwin, the banker, who lives at Huntington, Long Island. With an 8-inch air-cylinder it pumps 350 gallons an hour against a head of 50 feet—that is, lifts 350 gallons of water per hour to a hight of 50 feet. The consumption of gas is 15 feet per hour. With the same consumption of gas the 6-inch cylinder engine is capable of pumping 200 gallons an hour to the same hight. With coal as fuel, a scuttleful is ample for a day's run.

Oleomargarine.

As most of our readers will be aware, the manufacture of artificial butter from beef fat, has, within the past few years, attained to the rank of an important industry. Like every other new departure from well-worn grooves of custom, it has had to contend with much opposition, which in this case has been the more

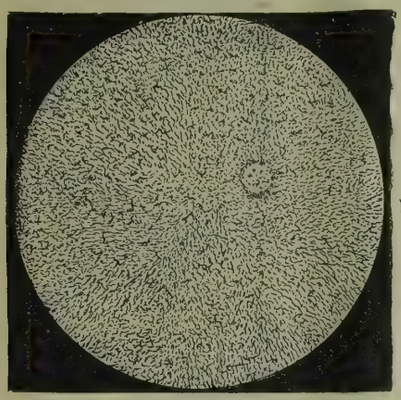


Fig. 1.

severe as the product, being designed as an article of food to take the place of natural butter, has been bitterly assailed and denounced as unwholesome, and even dangerous. The utterly baseless nature of these denunciations, coming as they did, and still to some extent do, from interested sources, has been sufficiently demonstrated by the enormous growth and extension of the manufacture of oleomargarine throughout the country, and by the almost unqualified endorsement of the entire chemical fraternity as to the wholesomeness of the product as an article of food, and as to the value of the industry in giving an enormously greater value to animal products that hitherto have been used for less important purposes. With these views we entirely concur, and from our knowledge of the subject, feel warranted in the opinion that the oleomargarine industry is worthy to rank in importance with the manufacture of sugar from the beet root, and a few other equally benificent industries that chemistry has conferred upon us. As it may be of some interest to certain of our readers to know the grounds upon which this opinion is based, we will give in brief a review of the process of making this new article of food.

To begin, we will refer to the fact that in the operation of fattening beef-cattle for the market, a large surplus of fat is stored away in various parts of the body —much in excess of our requirements for food, or for cooking purposes. This excess has been hitherto alto-

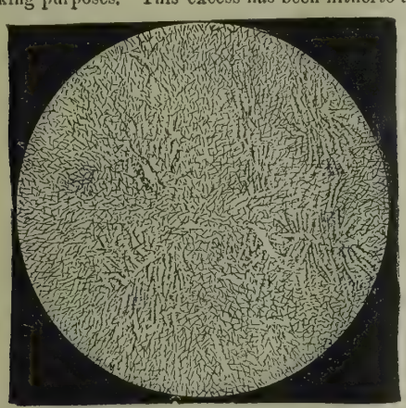


Fig. 2.

gether lost as an article of food, the only uses to which it could be put being to convert it into tallow, to be used in the production of soap or candles, or to be used for lubricating and similar crude applications. The wholesomeness of beef fat as an article of food being universally admitted, it is not surprising that it occurred several years ago to M. Mége, a French chemist, to endeavor to save to the food supply a portion of the immense quantities of fat used for the crude purposes above named. He was led to this thought by the knowledge that the only essential differences between the oil of butter and the oil of suet, were that the former contained a small percentage of certain compounds (butyric) which impart to it some of its peculiar flavor, and that it contained a much smaller proportion of the solid stearine to which the hardness and granular quality of suet are due. The results of Mége's study of the interesting problem of converting the surplus fat of beef-cattle into a food product, after many difficulties had been encountered, were ultimately quite satisfactory.

Mége's process is as close an imitation as possible of the process of natural butter-making. It consists substantially of three steps: 1st, The separation from the oily fat of suet of the cellular tissue and the excess of the stearine; 2d, the addition of the necessary proportion of butyric compounds, to give the peculiar butter flavor; and 3d, the solidifying of the butter-fat without grain, and the addition to it of the necessary proportions of water, salt and coloring matter. In the proper conduct of the Mége process, as perfected, the resulting product is a compound which is substantially the same in composition, appearance and flavor as butter churned from cream, without the addition of any deleterious substances, and without subjecting the substances handled to any process whereby its wholesomeness could be in any way injuriously affected.

The following is a description of the Mége process as carried on at the extensive works of the Commercial Manufacturing Co., at West 48th street, North River,

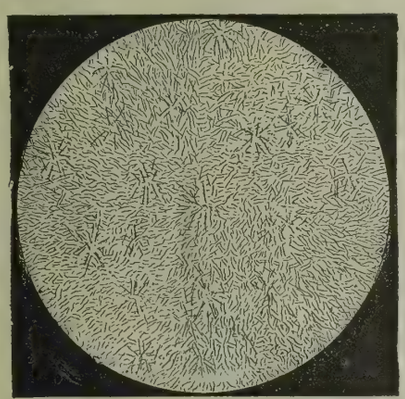


Fig. 3.

this city. The process begins with the selected fat from the abattoirs, which is received at the oleomargarine factory within a few hours after the killing. The first operation consists in thoroughly washing the fat from adhering blood and other impurities, which is done by soaking first in tepid water, then thoroughly washing in cold water. The pieces rich in oil are then carefully selected for butter-making, being severed from the pieces less rich in oil by a skillful cut, and the last-named are thrown into tubs that find their way to the tallow factory. The fat selected for butter-making, after another washing, is elevated to the floor above, where it undergoes the process of hashing and melting. The hashing machine is simply an iron cylinder provided with a number of revolving knife-blades, which cut up and completely disintegrate the fat as it is fed in at one end and forced out through a perforated plate at the other. The thorough breaking up of the tissues that has here taken place, is a very important step in the operation, since the oil separates from the fat in this condition at a low temperature, thus avoiding the necessity of a prolonged application of heat to effect the separation, as has hitherto been necessary in the melting of tallow. The effect of such excessive heating would be the development of a rank, tallowy flavor, which would be very objectionable.

The disintegrated fat is melted in cauldrons, which are surrounded with water, and the water being heated by steam, effects the melting of the fat when the temperature has reached 122° to 124° Fah. When the fat is completely melted, the contents of the cauldrons are allowed to stand until they deposit the fragments of membrane, which collect on the bottom, forming "scrap." On top is formed a thin layer of a white emulsion of oil and water, which is removed, and the clear yellow oil is drawn off into vessels which are removed to the press-room. Here they are allowed to rest while the oil granulates by the crystallization of its stearine, which is allowed to take place at a temperature of 85° Fahr. The melting process occu-

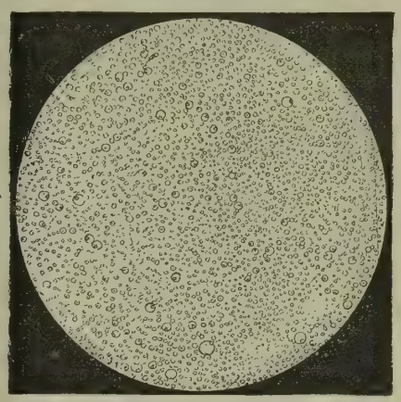


Fig. 4.

pies about two or three hours, and the granulation about 24 hours, or even longer.

The next step is to remove the separated stearine from the refined fat by straining under pressure. This is done by placing it in cloths set in molds, and placed on galvanized plates in a series of presses. When these are filled, the packages are subjected to a gradually increasing pressure, under which the fluid oil is expressed, leaving the hard cakes of stearine in the cloths, from which they are subsequently removed by a dexterous flirt of the cloth.

The resulting oily product is a clear, sweet, yellow oil, substantially the same as the oil of butter. In this condition it affords an excellent oil for cooking purposes, and formerly the larger portion of the product of the Commercial Manufacturing Co. was packed in this form for exportation.

To convert the butter-oil into butter, it is next churned with milk for about 20 minutes, by which it is thoroughly emulsionized or broken up into minute globules. At this stage, also, a small quantity of anatto is added to give a richer color to the product. The emulsionized oil is then drawn off into a tub of pounded ice, in which it cools suddenly without granulation. Here it is allowed to remain for two or three hours, after which it is thoroughly worked over by hand, and the pieces of ice removed. To impart the proper butter flavor, the solidified product must still be provided with more of the peculiar butyric ele-

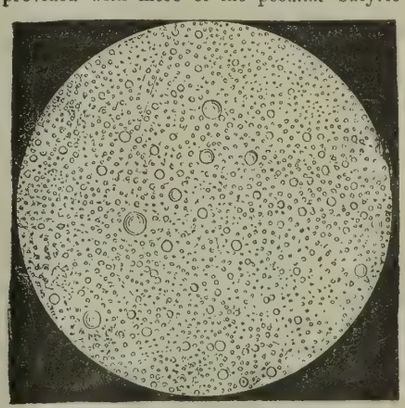


Fig. 5.

ments which give to fine natural butter its rich odor and flavor; and for this purpose it is again churned with about an equal quantity of milk. After this second churning, the butter goes through the same operations of working over, salting and packing, as ordinary butter, and the finished product—oleomargarine butter —when made in the manner above described, is substantially identical to butter made from cream, and while it is not equal in flavor to the best grades of

dairy butter, it is preferable, both in taste and smell, to much of the butter sold in the shops; and its very deficiency in those peculiar butyric elements that lend to the finest creamy butters their agreeable odor and flavor, is in one sense an advantage, since it renders oleomargarine butter much less liable to become rancid.

To satisfy any doubting minds of the substantial identity of the composition of natural and artificial butter, we give below the results of chemical analyses of the two products, made by Drs. Brown and Mott:

Constituents.		*No. 1. Natural Butter.*	*No. 2. Artificial Butter.*
Water		11,968	11,203
Butter solids		88,032	88,797
		100,000	100,000
Insol. fats	Olein, Palmatin, Stearine, Arachin, Myristin	23.824	24.893
		51.422	56.290
Sol. fats	Butyrin, Caprin, Caproin, Caprylin	7.432	1.823
Casein		.192	.631
Salt		5.162	5.160
Coloring matter		Trace.	Trace.
		88.032	88.797

A comparison of the figures in these two columns shows a deficiency, in the artificial product, of the volatile fats, which, as above stated, is partly a disadvantage and partly an advantage. From all that has preceded, it will be noticed that there is not a single objectionable operation in the Mége process of making artificial butter. In fact, the process requires for its proper performance, that the materials operated with shall be quite fresh, and that each operation shall be conducted with scrupulous cleanliness; and the wholesomeness of the finished product is obvious from the fact that its composition is substantially identical with that of the product of the dairy. If further testimony on this last point were required, it would be afforded by the inspection of the accompanying engravings, which give a comparison of oleomargarine and milk butter, as seen under the microscope. The plates are given on the authority of Prof. J. W. S. Arnold, of the University of New York:

Fig. 1 represents caul fat under the microscope, the crystalline nature of the adipose tissue being clearly seen, as also a globule of oil.

Fig. 2 represents oleomargarine before it is churned, or what is known as oleomargarine oil. It will be seen from this plate that oleomargarine, before being churned, is entirely in a crystalline condition.

Fig. 3 represents natural butter first melted and then allowed to cool slowly to a solid condition. The microscope shows the same crystallization as in oleomargarine oil (Fig. 2), from which it in no way differs.

Fig. 4 represents oleomargarine butter, and Fig. 5 natural butter. It will be seen by examination of these two figures, that they consist of an innumerable number of minute globules of varying size, and are substantially identical in appearance and in all other respects.

The manufacture of oleomargarine butter is now carried on in most of our leading cities and towns, and is rapidly extending, as the prejudices of the public and the opposition of the dealers in low grade butters are overcome. Already the industry has reached huge proportions, adding in its present state many millions of pounds to the food supply of the country, having more than double the money value of the crude product formerly obtained from the fat of beeves.

We repeat, in conclusion, that we are fully convinced of the great value of the discovery of Mége, which, as Chandler says, "marks an era in the chemistry of the fats," and place this opinion on record in the belief that it may serve to remove from the minds of some of our readers unreasonable prejudices or unfounded fears respecting a wholesome article of food.

An Electric Railway.—Messrs. Siemens & Halske have submitted to the municipal council of Berlin, a proposal for the erection of an electric railway—that is, a railway on which the cars will be propelled by dynamo-electric machines.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

The Steam Heating and Power Company, of this city, has filed plans at the Building Department for the erection of a factory to cost $20,000.

The Knickerbocker Gas-Light Company of this city is erecting a one-story brick and iron building for gas-works, to cost $22,000; Thomas J. Rowland, architect.

Madison Square Garden has been purchased by Barnum's Museum Company for $800,000. A building 200 by 425 feet and five stories high, to accommodate a coliseum, circus, ball-rooms, pedestrian track, etc., is to be erected. The work of demolition will commence Aug. 1.

Jardine Bros. are busy with an extension to be made to Altman's store at Nineteenth street and Sixth avenue, to cost $70,000. The extension, when completed, will be larger than the present main building. Fifty-two feet and more of iron fronting will be added to the Nineteenth street front, and running back 122 feet the new work will lap in an L for 103 feet towards Sixth avenue and a return of 56 feet will take it to the main building.

G. Schirmer, is about to build a music store at No. 35 Union Square. It is on the lot between Sarony on the north and Decker Bros. on the south. The designing has been done by D. & J. Jardine, architects, of Thirty-second street and Broadway. With a frontage of 30 feet, the building will run back on the first floor 140 feet, or the full depth of the lot. The front will be in brick with Ohio stone facings and the shop story will have a deeply recessed entrance with prominent show windows. There will be four stories above and at a total cost of $25,000 the work will transform another of the old-time residences of Union Square into a busy business place.

The following works are now being erected for this city: On Ward's Island, a west wing to the Insane Asylum, of brick, with Ohio stone finish, 80x200 ft., to cost about $150,000. On Blackwell's Island, an addition to the Retreat Building, of brick and stone, to cost $30,000; a brick laundry building for the Charity Hospital, to cost $15,000; two pavilions for the Almshouse, to cost $24,000; two pavilions for the Maternity Hospital, to cost $15,000; a fire-engine house, to cost $15,000; bath house etc., for Men's Almshouse, to cost $3,000; addition to Lunatic Asylum, of laundry, kitchen, and engine-house, to cost $12,000. On Randall's Island, a brick quarantine building, to cost $10,000. On Hart's Island, a pavilion for Insane Asylum, to cost $13,000; for Bellevue Hospital, a new pavilion, to cost $25,000; also an office waiting-room and Coroner's Jury room, with subterranean morgue on a new plan, to cost $15,000. Mr. Joseph M. Dunn is architect for all the buildings.

Geo. Fletcher Babb and Walter Cook, architects, of 57 Broadway, have prepared plans for a building at No. 55 Broadway, recently occupied as an office by the French Steamship line and the property of H. H. Houston, of Philadelphia. In times past when Bowling Green was the center of New York's fashionable life this building at the corner of Broadway and Tin Pot Alley, was the Cruger mansion. It was very well built on a full lot and at the end of a deep yard facing on Church street, or what was then Lumber street, were the Cruger stables. The new structure will cover the whole lot and will run back with a front on Church street, and in place of the modest 40 feet of the old residence this new business place will rise up 85 feet above the court. The alley on the north side is 12 feet wide and a special effort has been made to get all the light possible from it by means of a recess in the side of the building opening upon the staircase wall. The front of the building will be unique in the use of brick in connection with red freestone from Carlisle, England, the stone being of a precise red-brick tint. Above a basement of blue stone the front will be in this monocrome. By horizontal bands the apparent hight of the 25x85 ft. front will be kept down, while with four heavily splayed piers opportunity is given for novel arrangements of the windows. Some terra-cotta will be used in the front, and when finished the structure will be an important addition to lower Broadway. It is to cost about $100,000. and the Red Star Steamship Company will occupy the first floor and basement, with the National Storage Company in the upper part of the building.

Miscellaneous.

A new town hall is to be built at Thompsonville, Conn.

A factory is to be built for the Sibley Cotton Mill Co. at Augusta, Ga.

A new hotel is being built in Boston, by G. B. Taylor, at a cost of $30,000.

Blackstone, Mass., has voted to build a new town poor-house; cost, $45,000.

A new brick school-house, to cost $10,000, will be built at Kansas City, Mo.

N. H. Hall, of Baltimore, will erect a three-story brick and stone warehouse, 50 by 80 feet.

A school-house, after plans by C. A. Dietrich, is being built at Croydon, Ia., cost $10,000.

A Congregational church will be erected at Cleveland, O., at a cost of $30,000; Joseph Ireland, architect.

Jones & Laughlin will build one of the largest nail factories in the West at Chicago; dimensions, 150x268 feet.

W. H. Brown, the architect, is to build the new freight-house for the I. D. & S. R. R., at Indianapolis, Ind.; cost, $18,000.

St. John's Guild is about to erect a sea-side nursery at Cedar Grove, Staten Island. The expenses of building will be about $12,000.

A court-house to replace the present structure is to be built at Ebensburg, Pa. The site has been surveyed and work will be begun at once.

A Congregational Church will be built at Topeka, Kan., of Florence stone, at a cost of $15,000; B. J. Bartlett, of Des Moines, architect, and E. H. Homer, contractor.

A court-house is in process of erection at Napoleon, O. It will be entirely of stone, brick and iron, and will cost nearly $100,000. D. W. Gibbs, of Toledo, is the architect.

The Trustees of the Woonsocket Hospital Company, of Woonsocket, R. I., will erect buildings upon the cottage plan, as soon as a site can be obtained. The funds amount to $60,000.

A new school-house, 53 by 107 feet, will be built in Baltimore; E. F. Baldwin, architect. The same gentleman is also preparing drawings for the St. Leo Catholic Church, 53 by 95 feet, of brick, to cost $25,000.

Seven buildings are being erected by Horner Bros., of Philadelphia, for the manufacture of carpets, at the northwest corner of Fourth street and Lehigh avenue. Entire cost about $100,000; Walter H. Geissinger, architect and superintendent.

The St. Paul & Duluth Railroad Company has commenced an addition to its warehouse in Duluth, Minn., which will extend 100 feet to the north. Upon completion of the work the company will build a new flour warehouse 500 by 50 feet at the northern extremity of their slip.

A ferry-house is in process of construction at Hoboken, N. J., by the Hoboken Land and Improvement Company. The building is of very beautiful design and will have four slips and ample accommodation for passengers, besides every convenience for transacting the large business of the Delaware, Lackawanna & Western Railroad and the City of Hoboken.

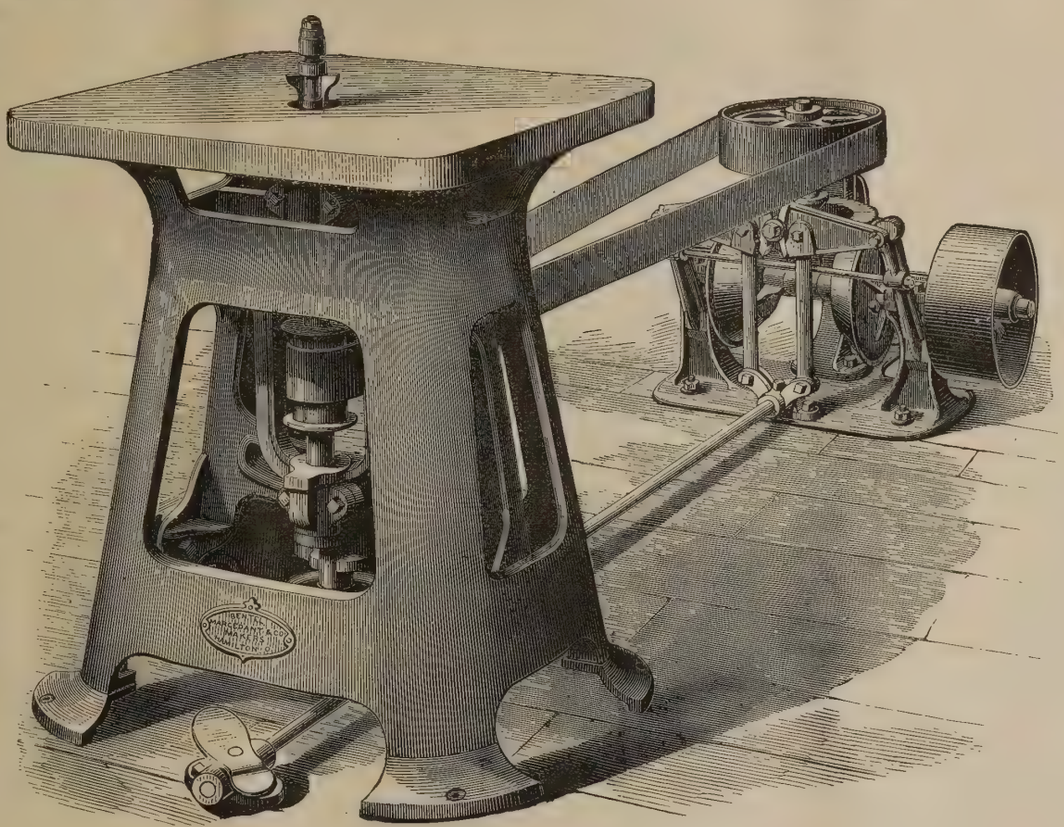
Edge-Molding Machine.

One of the most useful wood-cutting tools is the edge-molding machine, of which we here illustrate a representative machine manufactured by the well-known firm of Bentel, Margedant & Co., Hamilton, Ohio, manufacturers of wood-working machinery. Nearly every shop throughout the land has one or more of these tools in operation, and although they are called by different names, such as, friezing machines, Yankee whittlers, inside molders, Frazer's radial cutters, irregular molders, upright molders, shapers, or shaping machines, they are the same tools, and produce the same class of work. These different denominations are evidence of the general usefulness and applicability of the tool. There are two classes of this tool known, the double-spindle molding machine and the single-spindle machine. The names indicate the principal difference in their construction. One carries two spindles, of which one rotates to the right and the other to the left; while the single-spindle machine only carries one mandrel, which rotates either to the right or to the left, at the will of the operator. The old way of arranging the counter-shaft of the single-spindle machine, for the purpose of changing the direction of motion of the spindle, is the application of two driving belts from the line-shaft, one of which is twisted and the other runs straight, the shifter shifting and holding one of these belts on either one or the other of the tight pulleys, and the other belt on the loose pulley of the counter-shaft.

Our illustration shows the counter-shaft arranged in a different manner. It will be seen that it belongs to the class of friction counter-shafts, consisting in this case of two horizontal miter wheels, made of manilla packing-board and iron, and of one vertical miter wheel of cast iron. The horizontal shaft, with its manilla wheels and driving pulley, rests in long rigid bearings, and remains, while in rotation, laterally stationary, while the upper or vertical friction wheel hangs in a strong, webbed-pivoted frame, which has its fulcrum back of the wheel. It requires very little motion and power to bring the upper friction wheel in contact with either of the horizontal wheels, and thereby change the direction of rotation of the horizontal wheel and pulley, and that of the upright spindle of the machine, to which it is connected by means of the horizontal belt shown in the engraving. The operator of the machine changes the motion by pressing the treadle either up or down. This treadle is connected to a rod passing under the frame of the counter-shaft. The attachment of a double crank at its end connects it, by means of rods, to a pair of eccentric arms, which hold on their peripheries pinned rollers fastened on the swinging frame of the upper horizontal wheel. This arrangement of changing the motion from right to left, or to rest, is positive, quick-acting and unyielding. The whole arrangement is a decided improvement on the common friction counter-shaft now used. It also has all necessary arrangements for taking up wear.

The illustration shows the frame of the machine It is cast in one solid piece of great strength, and stands broadly on the floor, taking up all vibration, and the spider-webs of the housings are of improved pattern. The spindle is adjustable, and can be raised and lowered, and set at different angles to the face of the table, so that the pitch of the molding can be changed and the cutting made easy for deep or flat moldings. The spindle carries cast-steel stocks, independent of the spindle, which enables the operator to use stocks of larger or smaller diameter, to suit the work. Solid immovable, solid reversible, or flat cutters can be used, or cutters of other machines can be interchanged.

The manufacturers furnish the machine, when so ordered, at moderate cost, with different attachments for doing special work.



EDGE-MOLDING MACHINE.

For further particulars and prices, address the manufacturers as above.

The Manufacture of Resin and Turpentine.

From Wilmington, N. C., southward, and nearly all the way to Florida, the pitch-pine trees, with their blazed sides, attract the attention of the traveler. The lands for long stretches are almost worthless, and the only industry, beyond small patches for corn or cotton, is the "boxing" of the pitch-pine trees for the gum, as it is called, and the manufacture of turpentine and resin. There are several kinds of pine trees, including the white, spruce, yellow, Roumany, and pitch pine. The latter is the only valuable one for boxing, and differs a little from the yellow pine, with which it is sometimes confounded at the North. The owners of these pine lands generally lease the "privilege" for the business, and receive about $125 for a crop, which consists of 10,000 "boxes." The boxes are cavities cut into the tree near the ground, in such a way as to hold about a quart, and from one to four boxes are cut in each tree, the number depending upon its size. One man can attend to and gather the crop of 10,000 boxes during the season, which lasts from March to September. About three quarts of pitch or gum is the average production of each box; but to secure this amount, the bark of the tree above the box must be hacked away a little every fortnight. Doing this so often, and for successive seasons, removes the bark as high as can easily be reached, while the quality of the gum constantly decreases, in that it yields less spirit, as the turpentine is called, and then the trees are abandoned. The gum is scraped out of the boxes with a sort of wooden spoon, and at the close of the season, after the pitch on the exposed surface of the tree has become hard, it is removed by scraping, and is only good for resin, producing no spirit.

The gum sells for $1.50 a barrel to the distillers. From 16 barrels of the crude gum, which is about the average capacity of the stills, 80 gallons of turpentine and 10 barrels of resin are made. The resin sells for from $1.40 to $5 per barrel, according to quality, and just about pays for cost of gum and distilling, leaving the spirit, which sells for 40 cents a gallon, as the profit of the business. Immense quantities of resin await shipment at the stations along the line, and the pleasant odor enters the car windows as you are whirled along.

After the trees are unfit for further boxing, and are not suitable for lumber, they are sometimes used to manufacture tar; but the business is not very profitable, and is only done by large companies, who can thus use their surplus labor. The trees are cut up into wood, which is piled in a hole in the ground and covered with earth, and then burned the same as charcoal is burned elsewhere. The heat sweats out the gum, which, uniting with the smoke, runs off through a spout provided for the purpose. A cord of wood will make two barrels of tar, which sells for $1.50 per barrel, and costs 37½ cents to make. The charcoal is then sold for cooking purposes.

Lights for Light-Houses.

Sir William Thomson has lately made some suggestions respecting the above subject, which appear to be very practical and sensible. He proposes (1) a greater quickening of all revolving lights, (2) the application of a group of dot-dash signals to every fixed light, and (3) the abolition of color as a distinction for light-house lights, except for showing dangers, channels and ports by red, white and green sectors. His proposal is to distinguish every fixed light by a rapid group of two or three dot-dash eclipses; the dot of about half a second duration, the dash three times as long, with intervals of light about half a second each between the eclipses of the group, and of five or six seconds between the groups. The distinction by color alone ought to be prohibited, he says, for all light-house lights, on account of its liability to be confused with ships' and steamers' side-lights.

Such quick-revolving lights as he proposes, would be characteristic and practically as readily observed as a steady light, since its recurrence would be too

rapid to permit the eye to lose it when once observed. The use, also, of the system of dot-dash lights on seagoing vessels, which he urges, is a highly practical suggestion, since it would enable vessels, by employing the Morse alphabet, to communicate and interchange messages at night, either with each other or with light-houses or light-ships along the coast—an advantage that cannot be over-estimated.

An Improved Respirometer.

A Useful Invention.—Some time since Dr. Richardson, an English savant of eminence, made the startling assertion that a certain Mr. Fleuss had succeeded in devising a plan which enabled him to enter the water, and without any visible connection with the surface, to maintain himself under it for hours together. The doctor was profoundly astonished at this remarkable performance, which the inventor exhibited daily to crowds at the aquarium of the Polytechnic Institution in London, and expressed himself enthusiastically respecting the immense importance of this new plan to the art of submarine diving, which, in spite of many substantial improvements that have been made from time to time, is still far from being perfect.

It now appears that Dr. Richardson by no means overestimated the importance of the system devised by Mr. Fleuss, which, now that it has been made public, is as simple as it is scientific. Mr. Fleuss employs a modified form of diver's dress and helmet. The latter, which is no larger than that ordinarily used, has a close circular chamber of about ¼ cubic foot capacity, and in this he stores a supply of oxygen under a pressure of 240 pounds per square inch, from a suitably charged reservoir. This affords him sufficient air-food for about five hours. But how does he get rid of the expired carbonic acid? Nothing easier. The expired air from the lungs is passed, by means of a flexible tube, to a closed receptacle of vulcanite, which is attached to the yoke-piece carrying the usual rubber dress, which receptacle is filled with spongy rubber saturated with caustic soda. The expired breath is filtered through this soda, which absorbs every trace of carbonic acid, and allows the nitrogen to pass. The air in the diver's lungs and about his somewhat capacious clothing when he first puts on his suit, contains nitrogen enough for indefinite use, and is used again and again to dilute the oxygen, as the latter is constantly supplied from the compressed store in the helmet.

To describe the disposition of the several parts of this ingenious system and the details of valves, etc., by which the gas supply is regulated, would hardly be possible to do intelligently without an engraving. We simply wish here to call attention to the very important principle which Mr. Fleuss has introduced into the art of diving, by which the diver is rendered practically independent of an air supply from above. It will no doubt prove of great service, and we look upon it as a simple and beautiful solution of the problem of submarine diving, which it immensely simplifies and improves. It will be apparent, too, that by the use of Mr. Fleuss' system, firemen may enter burning buildings, smoke-laden apartments, and mines charged with choke-damp, to rescue human life in peril. Mr. Fleuss deserves the highest commendation for his invention, which, like all great inventions, surprises one with its simplicity.

New Dye from Poplar Wood.

Under the name of "Ericine," a fine golden-yellow dye is now prepared from the young wood of various poplars, as well as from the woody portions of heather, the botanical name of the latter (*Erica vulg.*) having apparently suggested that of the dye. Young branches and shoots of poplar are cut off, crushed, and brayed, and are then boiled in alum-water, the proportions allowed being 10 pounds of wood and 1 pound of powdered alum to each 3 gallons of water. The liquor is boiled from about twenty minutes to half an hour, and then filtered. In cooling it thickens and clears, throwing down a greenish-yellow deposit of resinous matter. When sufficiently clear, the liquor is again filtered, and then left exposed to the air for three or four days or more, according to the weather and the state of the atmosphere. It quickly oxidizes under the action of the light and air, and assumes a rich golden tint. In this state it can be used for dipping fabrics of all descriptions. For yellow and orange-yellow shades, it is used alone; mixed with Prussian blue, it gives green; with oak bark, brown and tan; with cochineal, etc., orange and scarlet shades. Or the coloring matter can be precipitated, and then makes a fine and perfectly innocuous yellow body-color for wall-hangings and such like purposes.

Rails.

The history of the rail commences with paving and tramways, the latter being smooth stone blocks for the

Railway Rails.

wheels on each side of a rougher track for the horses. These ways came to be made of timber, and eventually of iron, being at first simply flat strips laid on continuous sleepers, but finally bars, sufficiently strong to span the distance between transverse sleepers. From "Knight's Mechanical Dictionary" we take the accompanying engraving, showing various rail sections, and the following account of them:

Wooden railways were laid in Newcastle (England) as early as the year 1602. They were laid parallel and imbedded in the ordinary road. North, writing in 1676, says in reference to them: "The rollers of the carts were made to fit the rails." After a time the rails were laid on cross-ties and pinned to them.

Referring to the illustration, *a* shows a flat rail, consisting of flat plates of malleable iron nailed to the wooden rails; *b* (Carr's patent) represents a form of rail used in 1776 at the Duke of Norfolk's colliery, near Sheffield. It consisted of a cast-iron rail, with an upright flange, laid on wooden sleepers, and spiked down. The flange was put on the rail before it was put on the wheel. In 1793, wrought-iron bars, two or three inches in thickness, spiked to longitudinal sleepers, were used in connection with flanged wheels.

Wyatt's cast rail, of oval section (*c*), was used in connection with grooved wheels at the Penrhyn slate quarries in 1800; *d* shows the same, with the addition of the chair, a block of iron slotted to receive the ends of adjacent rails. The wheel had a tread of 2½ inches, and a flange to keep it on the rail; the sleepers were of wood; *e* represents Woodhouse's hollow rail, in use about 1803, having a channel for the rounded edge of the wheel; *f* is Blenkinsop's rack-rail, in use about 1811; *g* shows a square-bodied cast rail, about 1810; *h* shows Losh and Stevenson's flanged rail, 1816. Hawke, in 1817, devised a compound rail, consisting of a cast-iron face on a wrought-iron base; and Birkenshaw, in 1820, devised a rail having a malleable face on a cast-iron base. The latter was the first to make rolled rails, the iron, while hot, being passed between rollers grooved to the required pattern. Sections of these earlier rolled rails are shown in *i*, *j*, *k* and *l*; *m*, *n*, *o* and *p* show respectively the Spanish, Marseilles, Strasburg and Great Western (England) pattern; *q*, Durham and Sunderland (Eng.); *r*, Berlin and Pottsdam (Prussia); *s*, *t*, London and Blackwall, and Manchester and Birmingham, respectively; *u*, St. Etienne and Lyons (France); *v*, Wilmington and Susquehanna (U. S.); *w*, (old) Great Western (Eng.); *x*, London and Croydon (Eng.), which first dispensed with longitudinal sleepers and chairs; *y*, Morris and Prevost (Eng.); *z*, Birmingham and Gloucester, (Eng.); *a'*, *b'* and *c'* show sections of London and Birmingham, London and Brighton, and Midland counties (Eng.), respectively; *d'*, contractor's rail; *e'*, street-car rail; *f'*, locomotive street rail; *g'*, continuous rail; *h'*, tubular rail; *j'*, King's rail, with continuous cap; *k'*, Potter's rail, with steel facing rolled in; *l'*, Hymer's rail, with a steel upper section, iron foot and fish plate; *m'*, Ashcroft's rail, with a steel tread and double foot; *n'*, Jones' rail, with steel tread and forked foot; *o'*, Booth's rail, with an overlapping steel tread-plate; *p'*, Losh's fish-bellied rail and chair (1816), rail fastened with keys; *q'* shows Brunton and Shields' rail and chair; *r'*, English rail and chair of 1840; *s'*, Samuels' cast-iron sleeper; *t'*, Barlow's (English); *u'*, tubular socketed rail; *v'*, Seaton's saddled rail; *w'*, elastic rail; *x'*, Pierce's rail, on high standard; *y'*, Greave's pot-sleeper; *z'*, Reynolds' continuous bearing; *a''*, Stevenson's chair and rail; *b''*, Adams' rail; *c''*, Button's rail, with steel top; *d''*, Brooks' steel-capped rail; *e''*, Lewis'; *f''*, Hanmer and Grim's steel-topped rail; *g''*, Hagan's; *h''*, Chamber's rail, on elastic webs; *i''*, Robinson's double rail; *j''*, Pierce's; *k''*, Peckham's; *l''*, Perkins'; *m''*, Shephard's steel-top rail; *n''*, Day and Mercer's; *o''*, Dwight's; *p''*, Zahn's; *q''*, Johnson's; *r''*, Stephens' and Jenkins'; *s''*, Sanborn's tubular; *t''*, Sanborn's; *u''*, Angle's L rail, on continuous sleeper; *v''*, Dean and Coleman's street-car rail; *w''*, rail and sleeper for the East Indies. The sleeper is bent from a plate of wrought iron, to resist the attacks of insects which destroy wooden sleepers.

The first steel rail was rolled by Mushet, at the Ebber-Vale Iron Co.'s Works, South Wales, in 1857. It was rolled from cast blooms of Bessemer steel, and was laid down at Derby, England, where it remained in active service for 16 years, during which time 250 trains and at least 250 detached engines passed over it daily. Taking 312 working days in the year, we would have a total of 1,252,000 trains and the same number of engines and tenders that passed over it from the time it was first laid down until it was removed to be rolled over. The substitution of steel in place of iron for rails, which has been rendered possible by the Bessemer process, has worked a great change in the condition of our permanent ways in respect to giving them greater endurance, both in regard to wear and in resistance to shocks and strains.

Cement for Iron and Stone.—A mixture of litharge and glycerine hardens rapidly, and is said to make an excellent and durable cement for iron or stone work. It is not affected by exposure.

Boiler Explosion from Faulty Construction.

One of the clearest cases of a boiler explosion where the cause can be traced directly to faulty construction, and which affords an instructive lesson to would-be improvers of the steam generator where they are tempted to depart from generally accepted rules of construction, is described and illustrated in what follows:

The boiler referred to was a patent boiler, concerning which the most extravagant claims were made before half a dozen of them had been actually put in service. An explosion which occurred shortly after the first introduction of these boilers, while it justified the opinion of the inspectors of the Hartford Steam Boiler Inspection and Insurance Co., who have steadily refused to pass them, on the ground that they were unsafe, did not interfere with the pertinacity with which the makers affirmed their excellence.

The particular boiler whose history is about to be narrated, exploded at Holyoke, Mass., November 11, 1879. Its dimensions were as follows: Shell, 6 feet long; upper part, 22 inches diameter; lower part, 30 inches. In this there were 38 tubes, 6 feet long by 3 inches diameter; shell plates, ¼ inch thick; tubes, $^5/_{16}$ inch thick. The four braces—the ends of which are visible at A A, Fig. 1—were 9 inches wide and of $^5/_{16}$ths iron. The mode of fastening these braces is seen in Fig. 2, where they are shown attached below the small reverse curve of the waist, by means of four of the seam rivets, to each side of the boiler. The back tube plate was stiffened by short bars of angle iron, riveted on transversely above the tubes. The shell, as will be seen by consulting Fig. 1, was composed of three plates, two of which formed the cover of the upper part, and the third that of the lower part, a continuous seam on each side joining the upper plates to the lower one.

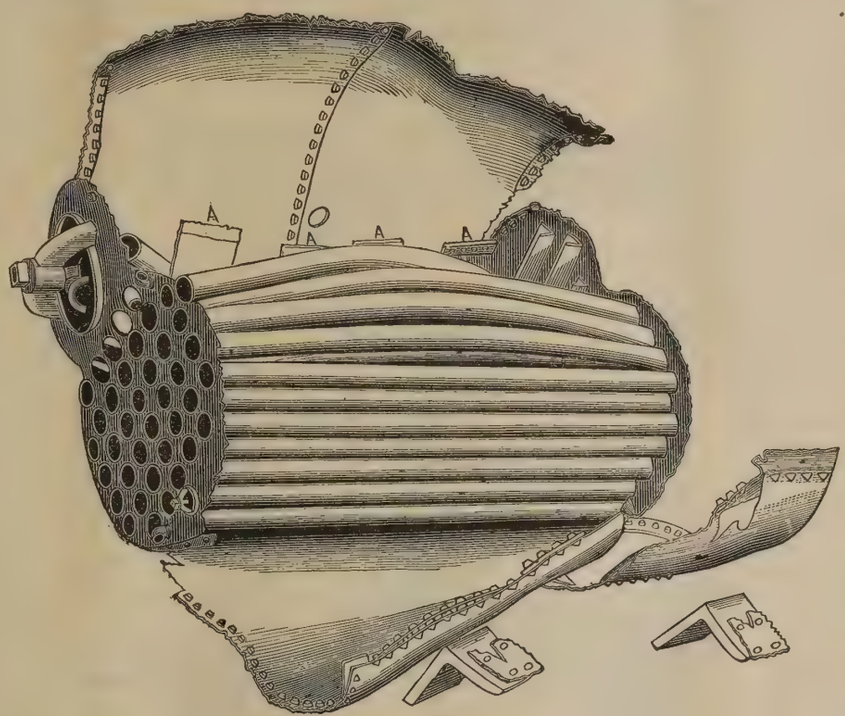


Fig. 1.

The plan of construction, therefore, shows a departure from the rules hitherto made use of, the idea of the inventor being apparently to construct a boiler similar to the Union boiler, with a continuous connection or leg. The execution of this idea, however, involves a fatal weakness of construction, which will shortly appear, and, which the event has shown, justifies the Hartford company in their refusal to insure them. By reference to Fig. 1, it will be seen that the outline of the end plates, which gives general outline of the boiler shell, is that of two parallel, incomplete and intersecting cylinders. The tendency of an internal pressure upon such a form as this must manifestly be to distend this compound form into that of a simple cylinder; and this must necessarily bring a powerful strain upon the angles of the braces (Fig. 2), tending to straighten them out. The effect of this strain upon the rivets fastening the braces to the seam, will be to pry them downward as the angle of the brace yields to the straightening effect of the strain—something like the effect of a "claw bar" on a spike in drawing it from its fastening. The correctness of this criticism will be obvious to any mechanical mind that studies the engravings, and further details of the setting of the boiler and its fittings are superfluous. The boiler was considered safe at 75 pounds working pressure, but at the time of the explosion the pressure was supposed to be from 40 to 50 pounds.

The theory of this explosion, advanced by the Hartford company, seems to be so perfectly justified by the facts, that we entirely coincide with it, and give it without further comment: "One of the middle braces, the second or third from the end, became so weakened by frequent motions, caused by the straightening tendency of the internal pressure, that it gave way at the angle (where it will be seen from the drawing, Fig. 1, that three of them are broken off). The rest of them, a little less weakened perhaps by the same cause, gave way in turn immediately, having received a sudden accession to their load, and the shell yielded and broke at the middle of the long seam, which may also have been weakened along the margin of the inner lap, as indicated by the leak on the left side. The shell being now fairly open, the steam and water rushed toward the place of least resistance, which was outward and upward, carrying the broken shell plates before them and tearing them from the end plates. The bending of the upper tubes indicates the direction which the water about them took in escaping, as does also the tearing out of the entire upper row of tubes, which, it will be seen from the one in sight on top of the cluster, were so much bent as to draw them from their setting in the tube plates. The four brackets which supported the boiler being below the opening, constituted the over-balancing resistance in the downward direction. Had the brackets been above the opening, the boiler would doubtless have gone high in the air instead of tumbling over and over to the left, as observed by the attendant, who caught sight of it just before the whole scene was enveloped in steam and dust. This *hypothesis* seems to be so well supported by the facts that the word is almost a misnomer."

Fig. 2.

How Pocket-Knives are Made.

The manufacture of pocket cutlery is one of the industries in which remarkable progress has lately been made in this country, and the products of our home manufactories will compare favorably with the best of foreign make. As this growing branch of industry possesses certain special details of interest, we give in what follows an account of the processes of manufacture employed, on the authority of a capable expert, who has witnessed the operation from first to last.

The best pocket cutlery blades are hand-forged—not cut or stamped out. They are usually made in three heats, perfect in form when leaving the anvil, except the beveling of the backs of the blades to guide engaging blades when closed into the handle. These bevels are formed by grinding. The steel is heated in a coke fire, and the blades are forged on an anvil set with dies—anvil and hammer being of peculiar form. A good forger seldom uses a gauge, the perfection of the form of the blade being assured by practice. An experienced forger will turn out about 30 pocket-blades, or 40 pen-blades, per hour. When the blades come from the forger, they are filed to make a nick between the blade and the tang, which is then ground and stamped with the manufacturer's trade-mark. The blades are then hardened and tempered, two at a time, being heated in a coke fire, plunged in water, and drawn over a fire. This work requires a practiced hand to secure evenness of temper. If the blades are sprung in the operation, they are straightened by blows from the poene of a hammer, the blows being delivered on the concave side. The blades are next ground, first on a Wickersley stone from England, and then on a Nova Scotia stone. The glazing or finishing of the blades is not done until they are put into the handles. This finish is produced on emery wheels, and finally on wheels of lead, fed with cake emery and crocus. The "scales" or linings of the handles are made of sheet-iron, brass, or German silver, punched in presses from sheets. When "bolsters" are used—that is, the metal finish placed at the ends of some handles—they are formed in drop-presses with dies, a teat or projection being formed on the inside of each at the same time, which enters a hole in the scale, and is secured to the same by a drop-press firmly riveting the two together. The central portion of the scale is recessed from the outside, to leave the upper portion somewhat projecting, in order that it shall insure a close fit with the material forming the outside of the handle. The springs are punched in dies from sheet steel, and then dropped between smooth dies to make them perfectly flat.

The blades, scales, springs, and the roughly sawed-out scale covers, are then assembled, placed in gauges or gigs, and the holes for riveting the handles, scales and springs, and that for the pivot of the blade, are drilled, and the parts temporarily united by wires in place of the rivets. The knife then goes to the cutter, who tempers the springs, rivets the parts, and completes the knife, except the final polishing and the "setting" or honing of the blades. The springs are heated over a charcoal fire, a dozen at a time being strung on a wire. The recesses in the handles to receive the name-plate are cut by a double rotary cutter, or two minute cutters rotated rapidly, the cutters being connected by a spring and guided by a hole of proper shape made through a steel template. Shoulders on the shanks of the cutters gauge the depth of the cut.

The final finish of the handles is given by rotten-stone on wheels of walrus hide. The handles are of mother-of-pearl, tortoise shell, ivory, buffalo horn, cocoa-wood, bone or ebony. The buck-horn or stag-horn handles are made principally for the Southern market, where they have the preference over all others. The rivets which form the pivots of the blades are made either of iron or German silver wire.

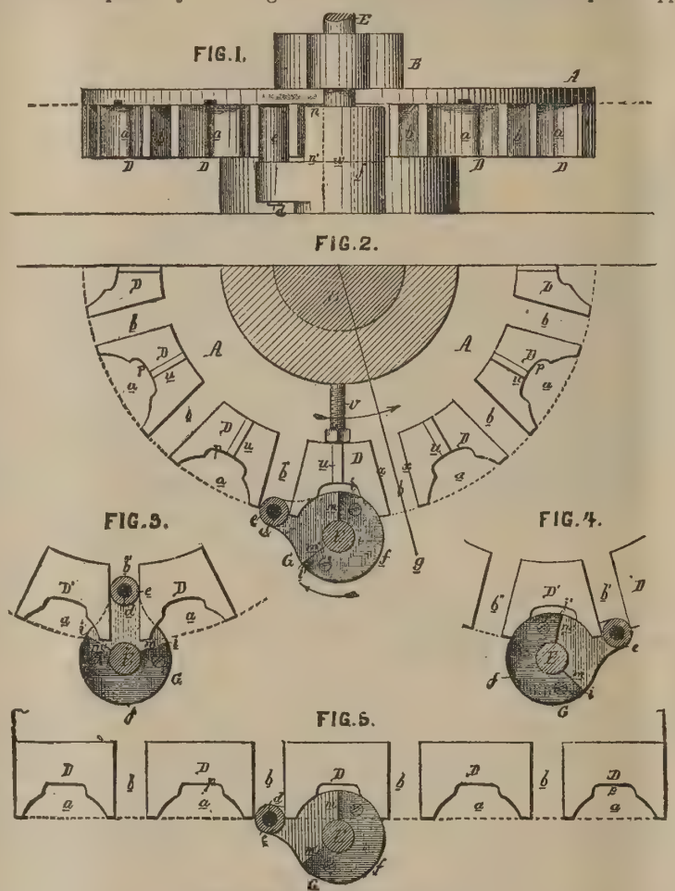
The Curled Pine.—Competent judges assert that

there is no wood more beautiful for ornamental cabinet work than the curled pine of Florida. It is eagerly sought after by European furniture makers, and much of it is shipped from Pensacola. It is said to be difficult to work, and must be handled by the best mechanics with the best tools; but the results obtained amply repay the care and skill expended on it.

A Novel Mechanical Movement.

We illustrate herewith a novel mechanical movement, devised for a specific purpose to meet an emergency occurring in shop practice, by Mr. John H. Cooper, Superintendent of the People's Works, Philadelphia, a well-known engineer and writer on mechanical subjects. The invention, which has been secured by United States letters-patent, consists of a device for converting a uniform rotary motion into intermittent movements, during the intervals between which the object operated on is locked. The device is shown in detail in the accompanying illustration, to which we refer in the appended description:

Fig. 1 is an edge view of the device; Fig. 2, a sectional plan view of half of the device on the line 1 2, Fig. 1; Figs. 3 and 4, detached views illustrating its operation; and Fig. 5, a diagram illustrating a modification of the same. In Figs. 1 and 2, A represents a wheel or disk arranged to turn on a shaft B, and to the under side of this disk is attached a series of blocks D, all alike in shape, and arranged in a circle concentric with the disk, and at equal distances apart from each other, the blocks being so formed that there shall be between them spaces *b*, each space having opposite parallel sides *x x*, Fig. 2, which are also parallel with a radial line *g* drawn from the center of the disk midway between the sides *x x*. E is the driving-shaft, to which is secured an arm G, having near its outer end a pin *d*, carrying a cylindrical roller *e*, which is of such a diameter as to fit snugly in, but pass freely through any of the spaces *b*, in the manner described hereafter. The hub *f* of the arm G is of the peculiar segmental form illustrated in the drawing, being cut away on the radial lines *m m'*, Fig. 2; and from the upper end *n*, Fig. 1, of the hub to the line *n'*, the periphery of this segmental hub is adapted to a segmental recess *a*, formed in each of the blocks, and each recess is cut away at *p* for a purpose rendered apparent hereafter. The arm G is supposed to be turning continuously in the direction of the arrows, and, as seen in Fig. 2, the roller of the arm is on the point of entering the space *b'*; on the further turning of the arm, the disk A must necessarily be turned in the direction of its arrow, the corner *i* of the segmental hub *f* at the same time receding so as to offer no impediment to the free turning of the disk. By the time the arm G has reached the position shown in Fig. 3, the disk will have completed one half of one movement, and the corner *i* of the segmental hub will be entirely free from the recess *a* of the block D, while the corner *i'* is approaching the recess of the block D'. As the movement of the arm continues, the disk A will continue to turn in the direction of the arrow, the segmental hub gradually taking its place within the recess *a* of the block D', until the arm arrives at the position shown in Fig. 4, when its roller *e* is about to leave the space *b'*, after which is can have no further control of the disk, which is locked by the segmental hub, owing to a portion of the latter fitting the recess *a* of the block D'; and the hub, as the arm continues to turn, will continue to retain and lock the disk until its roller *e* enters the next space b^2, Fig. 4, when the disk, freed from the control of the hub, will commence a second movement. It will thus be seen that the disk is controlled in its movements by the roller of the arm G, and that the locking of the disk is effected by the segmental hub, the several parts being so accurately arranged in respect to each other that the disk is never free from the control of the hub until the roller is in a position to turn the disk—in other words, as the arm G revolves, the disk is either being moved by the roller of the arm or is locked by the hub of the same. The recesses *p* in the recesses *a* of the blocks are necessary for permitting the corners *i* and *i'* of the hub to take the course pointed out in the recesses *a*. Although the segmental portion of the hub may form a part of the arm, the inventor prefers to make it separate, as shown by the line *w*, and to secure it to the arm by suitable bolts and screws, so that the segmental portion can be adjusted at pleasure, or renewed when worn, to be replaced by a new segment.



Novel Mechanical Movement.

The above described movement is applicable to many machines, and under many circumstances but one example of its applicability will suffice to illustrate the importance of the invention. In molding soap, crude blocks of that material are placed in chambers of the proper size and configuration for imparting the desired form to the block, and the pressure on the latter is accomplished by means of a heavy falling plunger, which must enter and exactly coincide with the chambers. The chambers may be formed on the disk A, and be arranged radially on the same, or a circle concentric with the axis of the disk, and one plunger may be raised and permitted to fall successively into every chamber containing the soap. It is of the greatest importance that the disk should be immovably locked and in the proper position during the falling of the plunger, so that the latter may coincide with the chamber which it has to enter; it is also important that, as the plunger is elevated free from the chamber, the disk should be promptly and accurately moved to the desired extent for bringing another chamber directly beneath the plunger. It will be evident that the above described mechanical movements will meet all these requirements.

Fig. 5 illustrates the invention as applied to the transmitting of an intermittent movement in a straight line. In this case the blocks are secured to a horizontal guided slide or table, such, for instance, as that which carries the plate to be punched by a punching machine. On turning the arm G, the slide will be moved determinate distances, at intervals between which the slide will be effectually locked by the segmental hub of the arm, so that there can be no movement of the slide during the action of the punch on the plate. Many other applications of this modification of the invention will readily suggest themselves to experienced mechanics. In most cases, it is preferable to so secure the blocks D that they can be adjusted on the disk, as in Fig. 2, for instance, where each block has a rib *u* adapted to a radial guiding groove in the disk, and each block can be adjusted by means of a screw *v*, and secured after adjustment by any appropriate appliances. The roller at the end of the arm can be readily removed, and replaced with such a roller as may coincide with the spaces between the blocks, these spaces varying in width in accordance with the adjustment of the blocks. In many cases, however, the disk may be furnished with permanent blocks D.

Selecting Tool-Steel.

Hardness, tenacity, facility for working under the hammer, and of receiving temper, are requisites of good tool-steel. The presence or absence of some of these qualities cannot be ascertained except by actual experiment; yet good judgment will enable a man to ascertain, with an approach to accuracy, the quality of steel without subjecting it to the action of fire and water and the hammer.

Pure iron contains no carbon; but tool-steel contains from one to two per cent. So small is this amount, that it is not surprising that it requires judgment and experience to select steel in the bar. One of the tests is to apply a drop of nitric acid to the surface of a fresh fracture. It will leave a black stain on good steel, but not on iron or low steel. Another test is to observe the color and texture of a freshly made fracture. This should present a fine grain, with a dull, silvery luster, and of uniform color. Poor steel may show a close grain, but it will be mottled in color.

But the only sure test is in working the steel. Draw the end of the bar, heated to cherry-red, under the hammer, to a fine point. If it will admit of being so pointed, that is a good indication. Plunge it into the hardening bath while hot; and, when chilled, give it a few gentle blows with the hammer. If it is tough and does not fly, but requires some hammering and bending back and forth to break it, that is another good indication. If the fracture shows a fine, even, lively grain, the test is complete, and the workman may be satisfied. One of the best tests is to make and temper a cold-chisel from the bar. If it stands well the chipping on a casting, the steel will make good turning tools. But, after all, the good judgment of the experienced forger is worth more than empirical tests.

Black Walnut in the West.

Some alarm is felt in Iowa over the rapid destruction of her black walnut forests. All along the railroads of that State, out-door steam saw-mills may be seen converting black walnut logs into slabs for shipment to England, which country seems disposed to make a raid on us for this timber. In fact, all over the West, in the black walnut belt, these little saw-mills are cutting up into a certain form of broad and thick slabs all the black walnut that can be got hold of. A

large and wealthy corporation, coöperating with a company of English capitalists, are the proprietors of these mills. They have their buyers out at every little station and in the rural districts, and wherever the smallest patch of black walnut can be found.

When it is remembered how Ohio and Indiana were once rich in tracts of black walnut timber, and how ruthlessly the woodman's axe has devastated thousands of acres, it is not surprising that Iowa should exhibit some anxiety regarding her future supply of this valuable wood.

A New Anæsthetic.

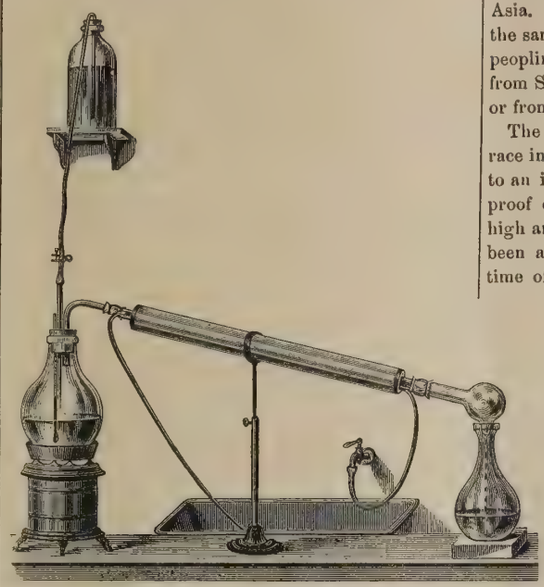
Bromide of Ethyl.—Two Philadelphia physicians, Drs. Laurence Turnbull and R. J. Levis, have lately presented the claims of bromide of ethyl (hydrobromic ether) as an anæsthetic; and as the result of an extensive practical experience with it, they express no doubt of its superiority to either chloroform or ether. This discovery, which emanates from very respectable authority, will doubtless prove of much value to medical science, inasmuch as neither of the two anæsthetic agents—ether or chloroform—commonly employed, fully meets the requirements of a perfect anæsthetic agent; ether being notoriously slow and more or less uncertain in its action, and chloroform having the objection of being not altogether free from danger in its depressing influence on the action of the heart and the respiration. The wants of the medical profession in this direction were so fully recognized by the British Medical Association, that at one of its late meetings, a committee was appointed to thoroughly investigate the subject, with the view, if possible, of discovering some anæsthetic agent or agents that would be free from the objections advanced against chloroform and ether. We mention this fact simply to show the importance of such a discovery as Drs. Turnbull and Levis claim to have made.

The following are the more important facts as given by Dr. Levis respecting the physiological effects of the new agent, which will be found described at length in the medical journals of the day:

"Its principal physiological characteristics which will concern the surgeon, are its rapidity of action and the quickness of recovery from its effects. As far as observed by me, it does not influence the circulation, excepting to sometimes produce a slight increase in the rapidity of the heart's action and in arterial tension or pressure. The cerebral anæmia and the fatal syncope of cardiac depression, to which chloroform is liable, are dangers which do not appear to threaten in the anæsthesia of the bromide of ethyl. Respiration is but little influenced by the bromide of ethyl, as I have administered it, beyond the ordinary characteristics of all anæsthetic sleep; but in this respect its action seems more to resemble that of ether than that of chloroform. While making these assertions, I fully recognize the fact that the ultimate effects of all anæsthetics show that they are depressing agents. Nausea and vomiting appear to occur less frequently in the anæthesia of the bromide of ethyl than in that of ether or of chloroform, and the rapidity of recovery from its effects must render such impressions very brief and transient. Commencing with the occasional and very cautious use of the agent, I have more recently adopted it to the exclusion of other anæsthetics. Anæsthesia with the bromide of ethyl is usually effected in from two to four minutes. The most rapid production of complete insensibility, in my experience, has been in one minute, in the case of a girl eight years old; the longest period has not in any case exceeded five minutes. The recovery from its effects is more rapid than with chloroform, in the greater number of cases the time not exceeding two minutes after the inhalation has ceased. Muscular coördination is so quickly regained, that the patient is often able at once to stand and to walk on awakening from profound anæsthesia. The pupils usually dilate as soon as complete anæsthesia is induced, and, as the sentient state returns, they resume their normal condition. I suggest that the condition of the pupils may be an index and guide in the administration."

Dr. J. Marion Sims, at a late meeting of the New York Academy of Medicine, read a paper describing his experience with bromide of ethyl, and confirming the favorable opinion expressed of its value to the profession, made by his Philadelphia colleagues. The announcement of this discovery has very naturally attracted much attention from physicians and surgeons throughout the country, and the medical fraternity will soon be in possession of facts enough relating to it, to establish its proper rank among the anæsthetic agents.

In a series of experiments intended to ascertain the best process that could be adopted, should it be deemed advisable to introduce the new agent into the United States Pharmacopœia, the following procedure was proposed by Prof. Joseph P. Remington in the *American Journal of Pharmacy*, to which we are indebted for the accompanying engraving.



Apparatus for Manufacturing Bromide of Ethyl.

In this procedure the process of De Vrij, which depends upon the decomposition of potassium bromide by sulphuric acid in the presence of alcohol, was taken as a basis. The proportions selected for the working formula are as follows:

Potassium bromide (not powdered)	58 parts.
Sulphuric acid (spec. grav. 1.838)	44 "
Alcohol (95 per cent)	44 "
Water	28 "

An apparatus well adapted for the manufacture of bromide of ethyl is shown in the adjoined cut, which will be fully understood by simple inspection. The water and acid are first mixed, and after they have cooled the diluted acid is introduced into the flask upon the gas-stove, the potassium bromide is added, and the contents of the flask heated to a temperature of 116° C. (240.8° Fah.) The alcohol, contained in a bottle, is elevated above the flask, and, by means of the siphon tube and pinch-cock shown in cut, is fed slowly into the flask, care being taken to adjust the flow of liquid and the heat so that the temperature shall range between 100° and 116° C. (=212° to 240.8° Fah.) The advantage of this process, it is explained, consists in the fact that the decomposition takes place at a temperature that can be controlled with ease, and the formation of ethyl bromide goes on regularly and without danger.

The distinguishing properties of bromide of ethyl are as follows: It is a colorless, very volatile liquid, non-inflammable, having an agreeable odor, and a hot, saccharine taste; its specific gravity is 1.420 (water=1); it boils at 40° C. (=104° Fah.); it is very sparingly soluble in water, freely soluble in strong alcohol and ether.

Possible Origin of the Human Race on the American Continent.

Prof. Flowers, in a recent lecture on the "Anatomy of Man," before the London Royal College of Surgeons, discussed at some length the origin of man on the American continent. The views till lately held as to the peopling of America, may, he said, be grouped under two heads: 1. That the inhabitants of that continent were a distinct indigenous people, created in the country in which they were found, and therefore not related to those of any other land. This is the theory of the polygenistic school, but is probably not held by many scientific men of the present day. 2. The monogenists mostly believed that they are descended from an Asiatic people, who, in comparatively recent times, passed into America by way of Behring Straits, and thence spread gradually over the whole continent, as far as Cape Horn, and that their nearest allies must therefore be looked for in the northeastern regions of Asia. It has also been thought by those who have held the same general views, that at all events a partial repeopling of the American continent may have occurred from Southern Asia, by way of the Polynesian Islands, or from North Africa, across the Atlantic.

The discovery of the great antiquity of the human race in America, as well as in the Old World, has led to an important modification of these theories. The proof of a very considerable antiquity rests upon the high and independent state of civilization which had been attained by the Mexicans and Peruvians at the time of the Spanish conquest, and the evidence that that civilization had been preceded by several other stages of culture, following in succession through a great stretch of time. But the antiquity of the quasi-historical period thus brought out, is entirely thrown into the shade by the evidence now accumulating from various parts of the United States, Central America, and the Pampas, that man existed in those countries, and existed under much the same conditions of life, using precisely similar weapons and tools as in Europe during the pleistocene or quarternary geological period, and, perhaps, even further back in time. As in Europe his works are found associated with the remains of Elephas primigenius, and other extinct mammals, so in America are they found in contemporary deposits with those of Elephas columbi. If the inductions commonly made from these discoveries be accepted, and the fact admitted that men lived both in Europe and America before the surface of the earth had assumed its present geographical conformation, the data from which the problem of the peopling of America is to be solved are altogether changed.

Recent paleontological investigations, especially those carried on with such great success in the neighborhood of the Rocky mountains, show that an immense number of forms of terrestrial animals that were formerly supposed to be peculiar to the Old World, are abundant in the New; indeed many, such as horses, rhinoceroses, camels, etc., are more numerous in species and varieties in the latter, and therefore the means of land communication between the two must have been very different to what it is now. Taking all circumstances into consideration, it is quite as likely that Asiatic man may have been derived from America as the reverse, or both may have had their source in a common center, in some region of the earth now covered with sea.

The Campylometer is the name given by M. Gaumet to a pocket instrument which he has designed, and which is capable of giving at one reading, the metric length of any line, straight or curved on a map or plan; and the natural length corresponding to the graphic length on maps, with a scale of one-80,000th or one-100,000th, or multiples or sub-multiples of these scales.

Scientific.

Chemical Discovery.—The progress of chemistry, when viewed from the position attained by advanced workers in the science, presents possibilities of discovery in the near future that are calculated to startle even philosophers of the *nil admirare* sort.

The most obvious manifestation of change that meets the student of twenty years ago, is the revolution that has taken place in the nomenclature of the science—a change that has completely robbed his acids, alkalies and salts of their old familiar aspects, and which perhaps more forcibly than anything else indicates how complete has been the change in chemical thought within this comparatively brief period. But however radical may have been the changes that have taken place in the views of chemists respecting the methods of indicating the molecular arrangement of chemical compounds, these innovations are trifling when compared with the views entertained by certain advanced thinkers respecting other questions of prime importance.

The stability of the elements themselves is now being questioned. Lockyer, not long ago, advanced the opinion, based upon spectroscopic evidence, that the so-called chemical elements were in reality not simple, but compound bodies; and hardly had the chemical world recovered sufficiently from the perplexity into which Lockyer's bold hypothesis had cast it, than the brothers Meyer announced its most startling verification in their remarkable experimental dissociation of chlorine and the other hologens.

Changes of opinion no less radical have taken place likewise respecting the functions and properties of the different portions of the spectrum. It is now known that the whole of the spectrum acts actinically. Capt. Abney has demonstrated the fact most amply by preparing a form of silver bromide that is sensitive not only to the ultra-violet rays and the whole of the visible spectrum, but likewise to the infra-red, and has presented to the Chemical Society of London a magnificent map of the infra-red spectrum. How far these remarkable discoveries may pave the way to the realization of photographs in natural colors, or what surprises may be in store for us in the investigation of the infra-red absorption spectra of various substances, no one can venture to say.

We will now turn to another active field of discovery—that of organic chemistry—and progress no less remarkable confronts us. Following up the path opened by Hofmann, Perkins, Graebe and Lieberman, in producing the anilines and alizarin—the coloring principle of the madder root—other chemists no less diligent and far-sighted, are boldly attacking the problem of the constitution of other and even more complex substances, and it is by no means improbable that in the near future we may witness the artificial production of indigo and the organic alkaloids on a commercial scale.

The Heliograph.—The utility of mirrors as a mode of communicating intelligence by means of reflected flashes of light, has been repeatedly pointed out, and certain savage tribes are credited with using this method of communication with surprising effect, considering the crudity of the means employed. Of late the heliograph, as the instrument is called, has been more critically examined, and its capabilities have been amply demonstrated. It has already come to be used as an effective aid in engineering and military operations, the paraphernalia being simply a reflecting mirror and stand, and a pre-arranged code of signals. Armed with this simple instrument, it is only necessary to have sunshine, and from any properly selected high ground signals can be sent for a distance of fifty miles. The utility of the heliograph for military purposes was amply demonstrated during the late war in Afghanistan, where it rendered efficient service. The instrument, and the mode of using it, is thus described by one of the army correspondents:

"A 10-inch mirror—and this is the diameter of the ordinary field heliograph—is capable of reflecting the sun's rays in the form of a bright spot, or flare, to a distance of fifty miles, the signal at this interval being recognizable without the aid of a glass. That is to say, two trained sappers, each furnished with a mirror, can readily communicate with each other, supposing the sun is shining, with an interval of fifty miles between them, provided their stations are sufficiently high and no rising ground intervenes to stop the rays. The adjustment of the military heliograph is a very simple matter. An army leaves its base where a heliograph station is placed, and after travelling some miles, desires to communicate with the stay-at-homes. A hill in the locality is chosen, and a sapper ascends with his heliograph, which is simply a stand bearing a mirror, swung like the ordinary toilet looking-glass, except that besides swinging horizontally, it is also pivoted, so as to move vertically as well. Behind the mirror, in the very center, a little of the quicksilver has been removed, so that the sapper can go behind his instrument and look through a tiny hole in it toward the station he desires to signal. Having sighted the station by adjusting the mirror, he next proceeds to set up in front of the heliograph a rod, and upon this rod is a movable stud. This stud is manipulated like the foresight of a rifle, and the sapper again, standing behind his instrument, directs the adjustment of this stud until the hole in the mirror, the stud, and the distant station are in a line. The heliograph is then ready to work, and in order to flash signals so that they can be seen at a distance, the sapper has only to take care that his mirror reflects the sunshine on the stud just in front of him.

Paraffin and Sulphur Process for Sulphuretted Hydrogen.—Mention was made in our Science column some months ago of a procedure for the production of sulphuretted hydrogen by heating an intimate mixture of paraffin and sulphur. A method for the convenient production of this very unpleasant but indispensable reagent, would be a great boon to the analytical chemist. The process now universally followed, consists in generating the gas by the action of diluted sulphuric acid on a metallic sulphide, generally the proto-sulphide of iron; and it is open to the serious objection of requiring a continual replenishment of the materials to maintain a constant flow of gas for some time, and this involves the disagreeable necessity of tampering with the apparatus while it is at work, and likewise causing considerable wastage.

The new process above referred to, was therefore hailed with gratification by a host of chemists, since it was affirmed that the gas would be regularly evolved from the mixture of sulphur and paraffin on the application of moderate heat, and would cease at once on withdrawing the lamp, and there would be no waste. The practical test of the new procedure, however, does not seem to justify the claims that have been made for it. The fusion of sulphur and paraffin in a flask is usually followed by an explosion, caused by the stoppage of the evolution tube with sublimed sulphur, and the mixture spreads over the surface of the flask so as to totally prevent a glimpse at its contents. It is also affirmed that the gas evolved has a peculiarly offensive smell, though this last objection, we think, may have some connection with the mode of operating the process. It occurs to us that if the process were modified by employing, in place of sulphur, some compound that would liberate sulphur at a moderate heat, the objectionable features would be removed, and we therefore suggest such modification to our chemical readers.

New (?) Metallic Elements.—While on the one hand the researches of physicists are accumulating facts to demonstrate that the so-called chemical elements are not essentially simple bodies, the attention of chemists of late appears to have been chiefly directed to the work of discovering and adding more elements to the already formidable list. The number of alleged discoveries of this kind announced during the past year or so, is entirely without parallel. As nearly as we recall them, we have had announced to us—Samarium, Ytterbium, Philippium, Decipium, Holmium, Thulium, Mosandrium, Scandium, Norwegium, Vesbium, Ouralium, and several others that have not been dignified with names.

Many of these have been named simply upon the very slender evidence of "absorption spectra," and none, so far as we know, have been isolated. And so rapidly have announcements of these discoveries followed each other, that, as some of the investigators were working with the same (or similar) material, it is almost certain that several of the new announcements have been duplicated. The subject has been so much complicated by the great number of "preliminary announcements," that chemists have ceased their efforts to decide on the genuineness of most of them, and have, by mutual consent, settled down to wait quietly until some acknowledged master of the subject shall have thoroughly overhauled the mass of complicated and often conflicting evidence that has been published, and sifted the wheat from the chaff. While it is certain that some of these alleged discoveries are without substantial foundation, and that some have been duplicated, it is equally certain that others will be found to be real acquisitions to science.

Late reports in the French journals advise us that Delafontaine, a chemist of acknowledged eminence, whose name is prominently identified with several of these discoveries, has undertaken the laborious task of examining the claims of these new applicants for admission to the list of elements. He announces his belief that the earth's Ytterbia, Decipia and Philippia, are real additions to science, and considers as doubtful a number of others whose existence has been affirmed purely on the strength of absorption spectra. The examination which Delafontaine has instituted will probably be taken up by others, and we may soon hope to have the merits of these alleged discoveries properly estimated by the test of severe criticism.

Seeing by Electricity is the next surprise in store for us. The problem, astonishing as it may appear when first propounded, so far from being impossible of solution, is already so far advanced in the hands of several ingenious students of electricity, that its practicability has been established beyond question. Like many of the recent developments in this rich field of invention and discovery, this one may remain for a considerable time in such shape as to be of little practical service; but with the perfection of the apparatus and methods employed, the utility of the discovery will sooner or later be fully developed.

The principle which is made use of in solving the problem of "seeing" by electricity, or, to express it more accurately, of reproducing visual impressions at great distances, is the property possessed by the metalloid element, selenium, by which its electrical conductivity is modified by the action of light. The means by which this problem will be solved in practicable form, as we have no doubt it will be, are necessarily much more difficult to master than those required for the transmission of sound in the telephone. In the latter, we are only required to cause a succession of signals to follow one after the other, and this is readily accomplished by the use of a single wire. In the other case, an infinite number and variety of impressions must be transmitted instantaneously; and the difficulty of accomplishing this without the use of a multiplicity of wires is manifest. In this case, however, as in almost every other which seems to be surrounded with insuperable difficulties, the simplest methods and devices will probably be found to be the most effective in overcoming them.

Are the "Elements" Compound Bodies?—Lockyer's bold hypothesis that our so-called elementary substances were in reality compounds, has attracted universal attention in the scientific world, and the interest which it has aroused has been intensified by the late researches of the brothers Meyer of Zürich, which appear to place beyond question the fact that chlorine and iodine are really so dissociated at high temperatures. This seeming experimental verification of Lock-

yer's idea has originated some interesting suggestions respecting the further prosecution of this important inquiry. M. Raoul Pictet, a well-known physicist and inventor, has been led by these researches to propose an ingenious plan for demonstrating the dissociation of the metalloid elements, which he conceives to be possible. He argues that as the spectrum of the sun shows the entire absence there of the metalloids [save oxygen (?)—*Ed.*], this is a proof that the temperature of the solar surface is too high for them to exist there. He urges that if, by any means, we could obtain a very high temperature, or one greatly exceeding that which we have heretofore been able to obtain by artificial means, we would be able to dissociate the metalloids, and to obtain and examine the products of this dissociation. But how to obtain the necessary temperature is the difficulty; and in his proposal to overcome it, M. Pictet advances the following ingenious ideas: "We know that the rays of the sun traverse space without any diminution of their frequency or wave-length. It follows, therefore, that the sun's rays are able to raise to a temperature, equal to that of the sun's surface, any body on the surface of the earth on which they can be concentrated, provided only that such a body could be preserved from losing heat by conduction or radiation."

To do this, Pictet proposes the employment of a huge parabolic mirror, in the focus of which the sun's rays would be concentrated upon the various metalloids which it is sought to decompose. At the focus he proposes to place a "solar chamber," or crucible, constructed of lime, zinconia, or some other very resistant material, into which he would lead the vapors of the metalloid to be experimented on. To prevent loss of heat, he would heat this chamber by a series of oxy-hydrogen flames. By this arrangement he believes he would obtain a tremendous temperature. To catch and retain the decomposition products before they would have a chance to reunite, he proposes to aspirate them through metallic tubes containing wire gauze septa, and cooled from the outside by artificial refrigeration to about 50° below zero. The whole apparatus, as proposed by Pictet, would weigh about 6 tons.

Who was the Founder of Spectrum Analysis?—Lockyer asserts that the honor of being the founder of spectrum analysis of right must be accorded to the distinguished Swedish philosopher, Angström, who died in in the year 1874. He published a work in 1853, on "Optical Investigations," at Stockholm, in which he made use, for the first time, of a principle that had been propounded by Euler—namely, "that the particles of a body, in consequence of resonance, absorb principally those ætherial undulations or motions which are impressed upon them." He also endeavored to show that when a body is heated until it becomes incandescent, it emits the same kind of light and heat which it absorbs under other circumstances. He also made the further noteworthy statement, that "in many cases the Fraunhofer lines are the inversion of the bright lines which are observed in the spectra of various metals in the galvanic arc."

These statements of facts and principles are substantially those subsequently elaborated by Kirchhof, and they are the fundamental principles on which spectrum analysis is based. Lockyer explains that it was unfortunate for Angström that the language in which his first treatise was written, and other causes, prevented for three years its very existence being known.

Specific Gravity of Nickel and Cobalt.—Mr. John C. Trautwine, the well-known civil engineer, sends us the following estimations of the specific gravities of nickel and cobalt, rolled and cast, from material obtained from the American Nickel Works, Camden, N. J. As the values for the specific gravities of these metals are given differently by different authorities, Mr. Trautwine's figures, based on experiments with the purest material known in commerce, is of interest. The probable error of these figures, Mr. Trautwine states, will not exceed 1 in 150.

The specific gravity of cobalt (cast)=....8.37
" " " (rolled)=..8.32
" " " nickel (cast)=...8.28
" " " (rolled)=..8.58

The singular fact will be noticed in connection with the figures given for cobalt, that the specific gravity of the rolled metal is less than that of the cast; but the experimenter, in a note calling attention to this anomaly, remarks that "four repetitions of the trials leave no doubt of the fact *in this instance*."

Invisible Ink for Postal Cards.—Use a solution of cobalt or copper chloride mixed with a little gum. When dried, such writing is invisible, but becomes legible on being heated. A solution of ferrocyanide of potassium may also be used, but it requires a developer, for which sulphate of iron or copper may be employed.

A New Metallic Compound.

Abstract of a Paper Read Before the Society of Arts of London, by Grenville Cole, Ph.D.

(*Concluded from Page* 135, *June Number.*)

Mr. Wood, the secretary of this society, has had a medallion, which I sent him some time ago, exposed to all the recent fogs and frosts, on the outside of this building. You can judge and see for yourselves how well it has stood this test.

Not to confine myself to his test alone, I have here another medallion of this metal, which Mr. Wood informs me has been left for some time in aqua regia, one of the strongest acids known. You see how little effect the acid has had on the surface of the metal. I believe that no work of art in any other substance would bear this test without suffering. I will here endeavor to show you the effect the same acid has on marble or bronze. I venture to think that if Spence's metal has resisted this acid for a month, it ought certainly to be able to resist the climate of London for a very much longer period. I, therefore, beg to submit that this metal, if skilled labor is brought to bear on it, ought to be of great value for decorative purposes, both internal and external.

I will endeavor now to point out to you the uses to which this metal may be applied for industrial purposes; and I propose to divide these purposes under three heads: 1. Gas and water works. 2d. Chemical works. 3. Miscellaneous.

Gas and Water Works.—As practice is better than theory, I will simply relate, as best I can, those experiments which have been tried at the South Metropolitan Gas Works. Experiments, under the direction of Mr. Livesey, were made some weeks back; two pipes were joined by this metal in much less time than would have been taken had lead been employed. The pipes, after having been joined, were tested under pressure, but no leakage was found.

Method of Joining Pipes with Lead.—In order to show the special advantages this metal has over lead, it will be as well here, if I endeavor to tell you how gas or water pipes are joined when lead is used. The pipes having been laid together, the joint is packed with yarn; clay is then laid around the exterior of the joint, and the molten lead run in. Unfortunately, lead possesses the property of contracting on cooling. The leaden joint has, therefore, to be "calked," or, as it is called in the North, "staved." This calking, or staving, means wedging the lead into the joint, in order to obtain a perfectly tight joint. This calking naturally occupies considerable time, and necessitates excavation, in order to allow the men to work all around the pipes. Excavation and calking are both rendered unnecessary by the use of Spence's metal. The pipes have only to be laid together, and after the yarn has been forced into the joint and the clay placed, the liquid metal is run into the joint, the clay is removed, and the joint is finished. The metal does not splash in running into the mold, thus avoiding a great source of waste of material and danger to workmen.

Experiments were also tried to test the metal joints in the event of subsidence of the ground. Four lengths of 9-foot piping, 6 inches in diameter, were joined with the metal, and supported on trestles. After the metal had set, which it did in a few minutes, the center supports were knocked away, leaving only the two end ones. The 36 feet length of piping sank 7 inches, without showing, even after pressure, any leakage.

These experiments were so satisfactory, that the South Metropolitan Company have adopted the metal, and are now laying their pipes with it. Mr. Livesey, the chief engineer, in writing on the subject to Mr. Spence, says: "We have now only the test of time, and that, I think, we may take the risk of." Others of the London gas works, and a very large number of provincial gas works, are adopting it.

In the same way, it will be useful for water works. Mr. Hope, who undertook some experiments in Scotland, reports that at the Edinburgh water works two pipes were joined, and subjected to a pressure of 400 feet of water, which was as much as they could get on, without the joint showing any leakage. This is the greatest pressure which we have as yet been able to put it to; so what it will actually bear, I am not at present in a position to say. From a sanitary point of view, as water has no action on the metal, it would be extremely valuable for cisterns, instead of iron or lead. Being almost a non-conductor of cold, pipes might be lined with it to prevent the water from freezing.

Uses to Chemical Works.—The metal being less acted upon by acids than other metals, it may also be of service to chemical manufacturers. I refer especially to sulphuric acid, which is the most extensively used of all acids in commerce. Lead has, up to the present, been used for sulphuric acid tanks. I have myself tested the metal with sulphuric acid, and its action is almost imperceptible. The one objection to the use of this metal in this case, is its low fusing point; but when acids have only to be used up to a certain temperature, say 200° Fah., I venture to predict a large field for its use.

Besides the uses I have thus briefly, and, I am afraid, somewhat imperfectly set before you, there are many others to which the metal may be applied—for instance, joining iron to stone or wood, the tensile strain of the metal being from 650 pounds to the square inch, five minutes after setting. For joining railings to stone it would answer equally as well as lead, and cost very much less; also for coating the holds of ships. I have been told that an Act of Parliament has been passed, by which builders are compelled, if the district surveyors desire, to cover the walls of houses after they are built 2 feet out of the ground, with some material to prevent the damp from rising. It seems to me that Spence's metal is peculiarly adapted for this purpose.

I will illustrate some of the other uses to which this metal may be put: For hermetically sealing bottles; for covering cloth; for covering parcels that are being sent out to hot climates, thus obviating the use of lined boxes; for preserving fruit, or other articles of consumption; and I may state that experiments on a large scale are still being carried on at Mr. Spence's works, Belvedere, Kent.

I feel sure we have not yet come to the end of all the uses this Spence's metal may be put to, but I trust that I have shown sufficient to induce you and others who may be interested in this discovery to make further investigations. If my paper is somewhat shorter than usual, it is to some extent owing to my hesitation to make any statement which either Mr. Spence or I have not verified by actual experiment ourselves. I have already shown you a few of them—namely, casting on glass, casting an engraving, casting in metal molds, casting in plaster molds, casting in gelatine, resistance to atmospheric action, resistance to acids, resistance to acids as compared to bronze or marble, and uses in gas and water works. In conclusion, I express a hope that I have established the proposition with which I started, and I trust you are satisfied that this Spence's metal is a discovery which has a prospect of much utility to the fine and industrial arts, and that I have been justified in bringing it before the attention of the members of the society.

An Improved Windmill Pump.

Of late years, small windmills especially designed, with superior mechanical skill, have been rapidly growing in popularity, and have been extensively introduced, chiefly for pumping water, for which, in innumerable situations, their special adaptation, convenience, and economy make them most useful. The requirements of the stock farm, the country home, and

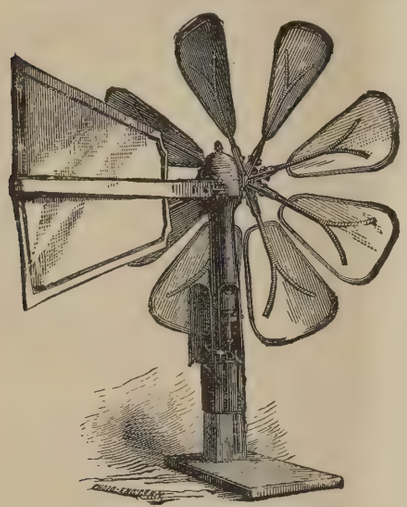


Fig. 1.—Windmill.

the railway watering station may be mentioned as evidences of the necessity of some such cheap and convenient pumping system as that we have named. The mere mention of these facts is, therefore, a sufficient introduction for a detailed description of one of the most effective devices of this class—the compressed air windmill pump, made by the Hartford Compressed Air Pump Co., of Hartford, Conn.

This pump differs essentially from those generally made, in that the wind-wheel is not employed to pump directly, but is made to compress air, which is caused to act upon and force the water as required. The abandonment of the direct pumping principle permits the use of a wind-wheel having fixed fans and rudder, which, from its superior lightness and simplicity, is preferable to the more cumbersome and complicated wheels with automatically adjustable fans, or pivoted rudder, to avoid wrecking in high gales. With the compressed air pump, the wheel and crank meet with the elastic resistance of a compressed air column at each stroke, instead of the solid shock which will be communicated from the piston of the ordinary pump; while in addition, the necessity of moving long and cumbrous rods is saved, since these are dispensed with by attaching the air compressor directly to the casting that supports the wind wheel.

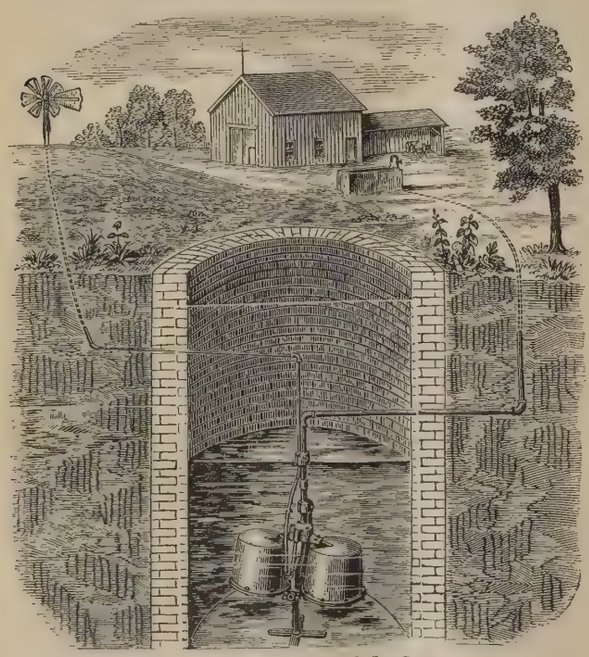


Fig. 3.—General View of the System.

Fig. 1 shows the form of mill employed. The crank and pitman are entirely covered, and no joints are exposed. The mill, it may be here noticed, can be located at any reasonable distance from the well that may be desired, on the score of appearance or better access of wind, as the compressed air can be conveyed in any direction and to considerable distances without material loss of pressure.

To return to our description; the compressed air is conveyed from the compressing pump, through a ½ to 1 inch iron pipe, according to size of pump (which varies from 2½ to 6 inches in diameter) to the well, where it is properly adjusted to operate the automatic buckets or engine, shown in Figs. 2 and 4. This engine is a peculiar feature of the apparatus, and will require a detailed explanation of its construction and action. It is submerged near the bottom of the well, and the compressed air conducted to it and does its work, as will appear hereafter. Two forms of this device are made—the oscillating and the stationary, both perfectly automatic in action. The oscillating form (Fig. 2) consists of two submerged water-chests, supported on a pivot, which rests on a fixed frame. The movement of the chests about their pivoted support gives them a certain amount of vertical motion—about 3 or 4 inches. At the bottom of each of these chests there is a valve opening upwards, for the admission of the water, and each is provided with a discharge pipe for the same. These discharge pipes are on the inner side (not shown in cut) and unite a single upright delivery main. An air-valve A, Fig. 2, is attached directly between the chests at the top, and determines the passage of the compressed air alternately from one chest to the other. The connection of parts is such that by a very simple arrangement this valve is operated by the rise and fall of the water-chests, as will be seen by what follows: The compressed air is always directed into the lower chest. When a certain amount of water has been expelled, the chest is lighter than the opposite one, and has a tendency to rise. When this tendency becomes sufficiently strong, the chest rises, the valve is changed, and the compressed air is instantly diverted to the opposite chest, which now occupies the lower position. The valve at each motion opens a suitable escape for the compressed air, which has already raised its bulk of water, and so allows the chest just emptied to refill through the valve at the bottom.

Fig. 3 shows the relations of the different elements of this apparatus. The windmill, located some distance off on high ground, for better access of the wind; the compressed air pipe, leading from the mill into the well and to the oscillating engine submerged therein; and the delivery pipe, leading from it on the opposite side.

The stationary bucket or engine (Fig. 4), consists of a stationary chest submerged in the well, and divided in such a manner as to make two entirely distinct chambers, from which alternately the water is forced. The slide valve is placed at a suitable distance above this chest, and above water. It is the same as that used on the oscillating buckets, but is moved by the rise and fall of two small copper boxes, which are alternately filled with water drawn in a minute stream from the upright main. The stream falls into whichever of the boxes is in the upper position, and when a certain weight of water has collected, the valve is thrown over, and the compressed air diverted to the other division of the bucket. This form of bucket can be used in a smaller well than is required for the oscillating bucket. It delivers a little less water, but is

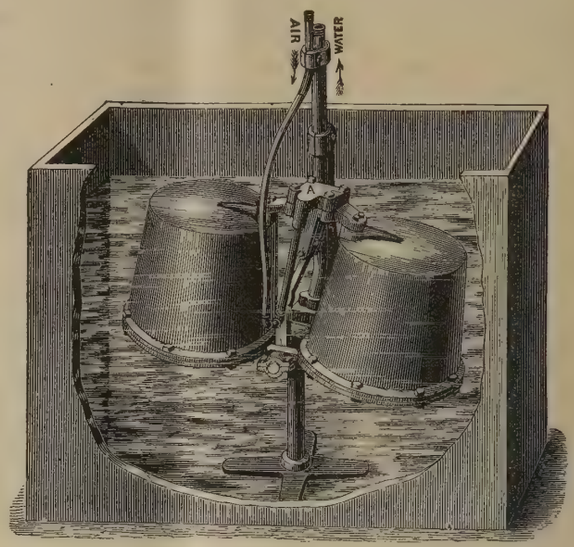


Fig. 2.—Oscillating Buckets.

preferable for high lifts. One size is made long and narrow, and can be put in an 8½ or 8-inch bored well.

The operation of this engine is affirmed to be simple and reliable. The makers supply larger sizes when large quantities of water are required to be raised to only a moderate hight.

The parts being made interchangeable, there is no difficulty in removing the one and putting the other in its place. We give in conclusion a *resumé* of the advantages claimed for this very ingenious apparatus by the manufacturers: Pump rods are dispensed with, and the wheel and air pump may be placed at any distance, and in any location that may be desired, independent

Fig. 4.—Stationary Bucket.

of the well. The elastic pressure of the air, and consequent absence of shock, makes it possible to use fixed instead of self-adjusting fans on all wheels of moderate size. They are noiseless in operation, and lighter and simpler than those of the class just named. The mode of applying the power is claimed to be economical. The machine is most effective when the wind is highest, while the self-regulating wind-wheels have a fixed limit which they cannot pass, and so have no increased efficiency in a gale. Because of this fact, and of the general economy of power, a smaller wind-wheel and pump will answer to produce a desired result.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$60 00 @ 70 00
Pine, good	52 00 @ 55 00
Pine, shipping box	20 00 @ 22 00
Pine, common box	17 00 @ 18 00
Pine, common box, ⅝	15 00 @ 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	42 @ — —
Pine, tally plank, 1¼, 2d quality	35 @ 38
Pine, tally plank, 1¼, culls	28 @ 30
Pine, tally boards, dressed, good	28 @ 30
Pine, tally boards, dressed, common	22 @ 25
Pine, tally boards, culls, dressed	22 @ 25
Pine, strip boards, merchantable	16 @ 18
Pine, strip boards, clear	22 @ 25
Pine, strip plank, dressed, clear	33 @ 35
Spruce boards, dressed	20 @ 22
Spruce plank, 1¼-inch, dressed	25 @ 28
Spruce plank, 2-inch	40 @ — —
Spruce wall strips	14 @ — 15
Spruce timber, per M	20 00 @ 25 00
Hemlock boards, per M	15 00 @ 16 00
Hemlock joist, 2½x4, each	15 @ — 16
Hemlock joist, 3x4	16 @ — 18
Hemlock joist, 4x6	40 @ — 44
Ash, good, per M	45 00 @ 47 00
Oak	50 00 @ 85 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 75 00
Chestnut	45 00 @ 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black walnut, good to choice	85 00 @100 00
Black walnut, ⅝-inch	75 00 @ 85 00
Black walnut, selected and seasoned	110 00 @150 00
Black walnut counters, per ft	15 @ 20
Cherry, wide, per M	85 00 @100 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 55 00
White wood, ⅝-inch	30 00 @ 45 00
White wood, ⅝ panels	35 00 @ 45 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	1 50 @ 1 60
Yellow dressed pine flooring	30 00 @ 37 50
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, per inch	18 @ 20
Locust posts, 10 feet	24 @ 25
Locust posts, 12 feet	29 @ 34
Chestnut posts, per ft	3 @ 3½
Basswood per M	25 00 @ 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	3 25 @	3 75
Up Rivers	4 50 @	5 00
Jersey	— — @	— —
Long Island	— — @	— —
Haverstraw Bay	5 00 @	5 25
" " choice	5 50 @	6 00
Favorite Brands	6 50 @	— —
Hollow Fire-Clay Brick	9 00 @	9 25

FRONTS.

Croton—Brown, per M.	10 00 @ 11 00
" Dark	11 00 @ 12 00
" Red	12 00 @ 13 00
Philadelphia	— — @ — —
Trenton	21 00 @ 22 00
Baltimore	38 00 @ — —
Clark's Ottawa White	25 00 @ — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1¼c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	23 00 @ 23 50
" Glengarnock	21 00 @ 22 00
" Eglinton	19 00 @ 20 00
" American, No. 1	24 00 @ 25 00
" American, No. 2	22 00 @ 24 00
" American, forge	20 00 @ 21 00

	Store prices.	Cash.
Bar, Swedes, ordinary sizes	— 6 @	— 6¼
Bar, Swedes, nail-rod	— 6½ @	— —

LEAD—PER 100 POUNDS.

*German	— — @ — —
*English, common	— — @ — —
*Spanish	5 75 @ — —
*Foreign, refined	— — @ — —
*Bar	6 50 @ — —
*Sheet	7 50 @ — —
*Pipe	— — @ — —
*Domestic	4 75 @ — —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 00 @ 3 10
8d and 9d, common	3 25 @ 3 35
6d and 7d, common	3 50 @ 3 60
4d and 5d, common	3 75 @ 3 85
3d and 4d, light	4 50 @ 4 60
3d, fine	5 25 @ 5 35
2d, fine	5 25 @ 5 35
Cut spikes, all sizes	3 25 @ 3 35
Clinch nails, 1½ to 1¾ inch	5 25 @ 5 65
do. 2 to 2¼ inch	5 00 @ 5 35
do. 2½ to 2¾ inch	4 75 @ 4 85
do. 3 inch and longer	4 50 @ 4 60

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	7 50 @ 7 75
*I. C. coke, 10x14	5 50 @ 7 00
*I. X. charcoal, 10x14	9 50 @ 9 75
*I. C. charcoal, 14x20	7 50 @ 7 75
*I. X. charcoal, 14x20	9 50 @ 9 75
*I. C. coke, 14x20	5 50 @ 7 00
*I. C. coke, terne, 14x20	6 00 @ 6 25
*I. C. charcoal, terne, 14x20	6 25 @ 6 75

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 7½ @ — 7¾
Sheet, (open)	— 8 @ — 8½

SOLDERS.

No. 1	— 11 @ — 12
No. 2	— 10½ @ — 10¾

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 @ 1 00
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown-Stone, Portland, Conn	1 30 @ 1 35
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Dorchester, N.B., Stone, rough, per foot	— — @ 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 @ 7 25
Chalk, per 100 lbs	— 35 @ — —
China Clay, per ton gold	18 00 @ 20 00
Chrome yellow, dry, per pound	— 12½ @ — 28
Lead, red American, per pound	— 8 @ — 9
Lead, white American, pure, in oil	— 9 @ — 9½
Lead, white American, pure, dry	— 8¾ @ — 8¾
Lead, white English, pure, in oil gold	— 9½ @ — 10½
Litharge	— 7½ @ — 8
*Ochre, Fr., dry, per 100 lbs	1 50 @ — —
Ochre, ground, in oil, per lb	— 6 @ — 15
Ochre, Vermont, per 100 lbs	— 75 @ 1 00
*Orange Mineral, English gold	— 9½ @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, per lb	— — @ — 25
Putty, per lb	— 2½ @ — 3
Spanish Brown, dry, per lb	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, per lb	— 8 @ — 9
Venetian red, per cwt	1 75 @ 2 00
*Vermilion, Chinese, per lb	— 85 @ — 90
*Vermilion, Trieste	— 70 @ — 75
*Vermilion, quicksilver, bags gold	— 60 @ — 62½
Vermilion, American, common	— 15 @ — 18
Whiting, per 100 lbs	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¼ @ — 9
Zinc, white French, in oil gold	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
do do	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

CEMENT—PER BARREL.

Portland (imported)	2 85 @ 3 25
Portland (American)	2 65 @ 3 00
Portland (Spanish)	2 50 @ 2 75
Portland (Lafarge)	3 20 @ 3 40
Portland (German, Bonner)	2 85 @ 3 25
Lime of Teil	2 20 @ 2 30
Lime of Teil, per ton	15 00 @ 18 00
Roman	2 75 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ — —
Rosendale	1 10 @ — —

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb. — 1¼ @ — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16 @ — 18
Goat, " "	— 21 @ — 25

SLATE.

Purple roofing slate, per square	$6 00 @ 6 50
Green slate	7 00 @ 7 50
Red slate	10 50 @ 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 @ 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 @ — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50 @ 4 00
Nova Scotia, blue	3 50 @ 3 75
Calcined, Eastern and city, per bbl	1 25 @ — —
Calcined, city casting	1 50 @ — —
Calcined, city superfine	1 75 @ — —

LIME—PER BARREL.

State, common	— 70 @ — —
" finishing	— 90 @ — —
Rockland, common, cargo rate	— 80 @ — —
" finishing	— 90 @ — —
Ground	— 80 @ — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 @ — 20
St. Domingo, crotches, fine	— 20 @ — 30
St. Domingo, logs, small	— 5 @ — 8
St. Domingo, logs, large	— 8½ @ — 14
Frontera, Mexican, large	— 9 @ — 12½
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ — 12½
Honduras	— 6 @ — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ @ — 6
Rio Janeiro, good to fine	— 5 @ — 8
Bahia, ordinary to good	— 2½ @ — 4½
Bahia, good to fine	— 5 @ — 8
Honduras, per ton	10 00 @ 20 00
Satin Wood, per foot	— 15 @ — 25
Tulipwood, per lb	— 6 @ — 7
Lignumvitæ, large, per ton	25 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 20 00

CEDAR.

Cuba, per superficial foot	— 8 @ — 11
Mexican, small	— 8 @ — 9½
Mexican, large	— 10 @ — 11
Florida	— 40 @ — 75

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,		$0 70
3	"	0 16	12	"	0 80
4	"	0 20	15	"	1 25
5	"	0 25	18	"	1 60
6	"	0 30	20	"	2 00
7	"	0 35	22	"	2 50
8	"	0 45	24	"	3 00
9	"	0 55			

REVIEW OF THE MARKETS.—In the lumber market the past month trade has been dull and the undertone heavy. There has not been a very decided pressure of supplies offering, especially of the more desirable qualities, and a great many places have been open for both quantity and assortment which would have to be filled before the accumulation could be considered as amounting to anything. Buyers, however, have been in an offish mood, and it has been impossible to induce them to move beyond well established and early requirements, unless they were able to secure the temptation of reduced cost. At the best, this is not a busy season of the year, and, of course, the operations of early spring anticipated a great many transactions that might now be under treaty to partially relieve the dull tone. Prices are let down easy, but the general tendency is in favor of buyers on all ordinary offerings.

In the brick market a good, steady call for stock has been found, and the continued moderate arrivals were sold without much difficulty as soon as offered, provided no great advance was asked, though under some circumstances a better price could be obtained. The accommodation of prompt or special delivery, and the attraction of extra quality of stock would give sellers an advantage. The consumption has continued quite as promising as ever, and while contractors are likely to lapse in demand a trifle after having secured enough to commence work, a great many bricks are sure to be required.

In the lime market a heavy feeling has developed, and prices have declined, with the situation still somewhat unsettled. Buyers, instead of taking hold more freely on the previous shading, seemed to become less inclined than ever to operate, and, as the supplies in the meantime were full, receivers slackened off the price as the only hope of securing custom. The decline sold a considerable quantity of lime, but the market has not yet recovered tone.

The lath market has remained in much the same condition as noted in our last report, though, if anything, there is a slight inclination toward a steadier tone. Fair arrivals have taken place, but none appear to be left over, and this indicates a little better demand than expected, while on prices a small improvement was obtained.

In the hardware market a dull trade is reported for about all kinds of stocks, and to pretty much every outlet, with few indications of immediate improvement. The great majority of the principal buyers have in hand a supply more than large enough to meet all the calls they can discover as likely to develop, while the few who are compelled to come upon the market, handle only just such amounts as will satisfy immediate necessities.

In the paint market demand has been slow and uncertain, and the few buyers who do appear, have shown very plainly that the force of actual necessity alone brings them upon the market. Business, in fact, has been most decidedly dull, and the feeling among holders of supplies by no means cheerful. No positive breakdown on values has occurred, nor is any thought to be likely, but constant little shadings have become a necessity in order to secure the small amount of trade afloat, and quotations are, to some extent, nominal.

In the metal markets American pig has had a somewhat uncertain market. Holders have talked freely, but buyers seem to consider the chances favorable for another break, under the belief that considerable speculative stock must be thrown over. Manufactured iron has sold very well indeed, and dealers say the distribution has been quite equal to the average for the season, but the offering has been quite liberal, every one with stock anxious to sell, and values very uncertain. Domestic pig lead has sold moderately, and mostly in a jobbing way, with the offering of stock fair and rates easy to quick buyers. Tin in pig has been in moderate, uncertain demand, with the undertone weak on all grades. Tin plates have found a dull market and rather weak prices.

Concerning Aluminum.

In view of the fact announced in our June number, of the establishment of the aluminum industry in this country, on what promises to be a successful basis, since the projectors of the new enterprise claim to have greatly improved and simplified the process of its manufacture, it may not be amiss to give a brief rehearsal of the peculiarities and applications of this metal.

The metal aluminum was first manufactured on a commercial scale about twenty-five years ago, and the credit of having created the industry by devising a practical process for its commercial production, belongs to the French chemist Deville. The production of a metal from clay, possessing such notable properties, created at the time a decided sensation, and so much importance was attached to Deville's investigations, that a factory for the production of the new metal was at once started at Javelle, near Paris, from the private purse of the late emperor of the French. Great expectations were formed of the future of the new industry, and it was confidently believed that aluminum, by reason of its characteristic and very unusual properties, would speedily take an important place in the arts as a substitute for many other metals, and for special uses of its own creation. That these expectations have been but partly realized, is now a matter of history. The causes of its limited introduction after so many years, in the face of its acknowledged adaptability, and even exceptional superiority, for many valuable uses in the arts, are difficult to assign; but they most probably arise partly from the difficulty of its production and the consequent high price of the metal, which has practically excluded it from competition with the cheaper metals—copper, zinc, tin, iron, and their alloys, and partly also from the difficulties encountered in casting, soldering, and otherwise manipulating it. These last-named difficulties have been largely overcome, and the latest advices show that the aluminum industry, though it has not grown so rapidly as was originally hoped, is firmly established, and that the metal has become an article of current manufacture, for which there is a moderate and steadily increasing demand. The only impediment that now stands in the way of the rapid expansion of the manufacture, is that of its cost, and if the promises of the American pioneers in this field may be relied on, this impediment has been removed.

A few words now concerning the metal itself. A fresh, clean surface of aluminum possesses a grayish-white color, something between that of zinc and tin. Its most characteristic property is its extreme lightness, which affords an immediate means of certainly identifying it. Its specific gravity is only 2.5 (water=1), which makes it three times lighter than copper, four times lighter than silver, and nearly eight times lighter than gold. It emits a clear, sonorus, musical tone when struck with the hammer. It is very permanent in the atmosphere. It may be hammered out into the thinnest leaves, rolled into plates, and drawn into the finest wire; its tensile strength approaches that of copper, and its hardness is about that of fine silver; its melting point lies at about 1,300° Fah., or midway between zinc and silver. It fuses with extreme slowness, and it does not vaporize even in the heat of the blast furnace. It may be readily filed, turned, pressed, engraved and coined, though it is somewhat difficult to cast and solder. (These last two difficulties, as before remarked, have been substantially overcome). With such an array of desirable qualities there must surely be a great future in store for this metal when the obstacle of a prohibitory price is removed.

Aluminum has been suggested for and applied to a great variety of uses. It has been suggested as a substitute in place of copper and silver for small coin—its indifference to atmospheric changes, color, klang, and its extreme lightness being properties that were appealed to as establishing its adaptability for such use; or a substitute for silver, etc., in the manufacture of jewelry and numberless articles of luxury. In this category may be named spoons and other domestic articles; lids and covers of glasses, pen-holders, smokers' and sportsmen's necessaries, shirt and sleeve buttons, cane, riding-whip and harness mountings, statuettes, gas-fixtures, lamps; and closely allied is its application to the clock-maker's art, and in the manufacture of surgical, philosophical and engineering instruments, in which its strength, stability, and especially its great lightness are particularly valuable.

The alloys of aluminum, and especially its alloys with copper—the so-called aluminum bronzes—have established a reputation and possess qualities that will ensure for them a constant and extensive demand. These bronzes contain, in the best known alloys, 5, 7½ and 10 per cent of aluminum. The first and last are of a golden color, while the second has a greenish tint. Even so small an addition as 1 per cent of aluminum to copper gives it greater ductility and hardness, and otherwise improves it. The aluminum bronze polishes beautifully, and possesses great strength—according to Anderson's experiments, an average of 75,618½ pounds per square inch. It is 40 times as rigid as brass and 3 times as rigid as ordinary bronze. It makes excellent castings, filling the mold perfectly; it works well under the tool, does not clog the file, and may be rolled into sheets, etc. Biederman recommends it highly as being preferable to all other metals for physical, geodic and astronomical instruments. It is largely used for artistic purposes. Gun and pistol barrels and cannon have been made of it, and have done good service. It has been suggested for type metal—type made from it lasting far longer than those of common type metal; and for many other useful purposes too numerous to specify.

Of late an alloy of aluminum-iron has been highly recommended for wire for telegraphic purposes, the same being affirmed on the strength of extended experiments by German electricians to be preferable to ordinary covered or galvanized iron wire, for the purpose, by reason of its strength, very superior lightness and electric conductivity; and the American manufacturers before referred to, produce an alloy of nickel and aluminum to be used in place of pure nickel anodes in electroplating, the deposited coating in this case being a white metal—an aluminum-nickel alloy—susceptible of taking a high polish, very permanent and indifferent to atmospheric influences.

In conclusion, we present, in confirmation of the foregoing claims respecting the varied adaptability of this remarkable metal, a brief summary of the various exhibits of aluminum at the late Paris Exhibition, which we give on the strength of published accounts in the technical journals while the exhibition was in progress. The exhibition contained one balance, the beam of which was made of pure aluminum. This balance was exhibited by M. Collot; it carried 100 grammes, turning at 0.1 milligramme; its price was set at $400. In France, the great chemical manufactory of H. Merle & Co., in Salindres, near Alais, carries on the extraction of aluminum, and the Société Anonyme d'Aluminum, in Nanterre (Seine), works up the metal into the various forms demanded by commerce. Both firms were represented at the Exhibition. Merle & Co. had a splendid display of bars of the metal, while the Société Anonyme exhibited samples of finished goods of all kinds, showing the progress made in its adaptation to various purposes. But for this it would not have been possible to exhibit reels of brilliant wire, fine as human hair, or beautiful sheets of extraordinary ductility. There were also exhibited stampings in aluminum—large medallions and pieces weighing exactly one gram, to show the lightness, compared with the bulk of the metal. In one pan of a balance there were shown five large keys made of aluminum, which were counterpoised by a single iron key in the other pan. The peculiar bluish-white luster of the metal also compared to advantage with the use of tin and zinc. The beautiful objects, made with great skill, of aluminum bronze, and sold at very cheap rates, were more popular than those made in pure aluminum, which is relatively dearer. Small articles of aluminum only are found to sell; among them may be especially named some pretty specimens of fine wire-work. It is getting to be a common thing in Paris to make the frames for opera-glasses and telescopes of aluminum. Houses which cultivate this branch of manufacture with success, are Clermont, Lemair, and Fischer. Still, successful as is this application of aluminum, it is perhaps not the most favorable one. The most rational use indicated for aluminum, by reason of its low specific gravity, is the making of beams for balances. Aluminum bronze beams have been made for several years past; but, so far as lightness of metal is concerned, they have scarcely any advantage over brass. Sartorious, of Göttingen, was the first who made light and unalterable beams of an alloy of aluminum with 4 per cent of silver. He has had but few imitators.

To the preceding we will simply add in conclusion, that in considering the question of the relative cost of aluminum in comparison with that of other metals for which it is designed to be used as a substitute, it must be remembered that even at double or treble the cost of tin, copper, etc., the former, by virtue of its eminent lightness, and consequent greatly superior bulk, weight for weight, will be as cheap, or cheaper, to use than the last-named metals, which, being much heavier, give correspondingly less material for service. This important feature is often overlooked in the consideration of the aluminum question.

The Army-Worm.

The army-worm, now devastating parts of Long Island and New Jersey, is so called because it appears in such large numbers, and because, like others of its species, it moves in columns and follows a leader. It is a caterpillar, the larva of a moth, and noted for its voracity, as it well may be, since it can eat, it is said, more than double its own weight in 24 hours. Although less gluttonous, as a rule, it is more destructive than the locust, from its greater fecundity and wider distribution over the vegetable world. It feeds on leaves, flowers, roots, buds, seeds, and even the wood of plants—indeed, it is nearly omnivorous. The worm is asserted to march in regular and exact order; it lives in society, and moves in procession either in single file, or two, three, and four abreast, the line being so perfect in the columns that the head of one is never beyond the head of another in the row. It follows the leader, stopping when the leader stops, making journeys from plant to plant or from tree to tree, in quest of food, and returning to its nest in the same order. The worms form ranks, march, and halt with the precision of soldiers. When several nests are in the same neighborhood, the going forth and coming back of the creeping battalions at the same hour, commonly toward nightfall, is very curious and interesting. Caterpillars include more than 1,000 varieties, there being 700 in New England alone. They all have 13 segments; the first consisting of jaw and mouth; the second, third and fourth of the thorax of the future insect, and the other segments of the abdomen. Their rapid growth and extraordinary consumption are shown by the common silk-worm, which, according to Vincenzo Dandolo's treatise on silk, increases, during the 30 days necessary to its full growth, from 1 to 40 lines in length, and from one-100th to about 95 grains in weight. In that time, therefore, it increases its weight 9,500 times, and eats 50,000 times its weight of food. In the Northern States there are about 1,000 kinds of butterflies and moths. As each female lays from 200 to 500 eggs, these species would produce, on an average, from each single female, 300,000 caterpillars in a year. If one-half of these were females, the second generation would be 45,000,000, and the third 6,750,000,000. With such fertility, it is easy to see that the destructive power of caterpillars, particularly of the army-worm, must be prodigious.

Before the adoption of the Bessemer process, Great Britain made only 50,000 tons of steel per year.

Home Department.

Art at Home.

Almost the first question with most of us in furnishing or decorating our homes, is, "What will it cost?" But side by side with this question, should be placed another of equal importance, namely, "How long will it last?" There is a common mistake in furnishing which too many people fall into. They like to furnish their houses, as they say, "thoroughly" in the course of a few weeks.

Now, to do this with really well-made and well-designed furniture is a very costly proceeding, and, it may be suggested, a very unnecessary one. It is true, the luxuries of modern life are so increased, that what our grandmothers would have considered superfluities, we now regard as necessaries, and accordingly, from the very outset, our drawing-rooms are often crowded up with chairs, couches and tables, the first uncomfortable, and the last, alas! often weak upon their legs, and apt to turn over if they are touched by a passer-by. The question of cost, therefore, resolves itself into this: For the decoration of a room, so far as the woodwork and walls are concerned, it costs no more to put on good colors in paint and paper than bad ones.

Having now completed the walls and wood-work, the rest of the room may be, if it is so wished, furnished in a temporary manner as cheaply as possible. A plain green or brown drugget may be laid on the floor. Curtains of plain, rough serge may be hung up, or curtains may be dispensed with altogether, and shades of some dark color put up. Then half a dozen really necessary pieces of furniture, well constructed and made to last, may be added, and for the present the room will be complete. It may be called bare, but there will be nothing in it to weary the mind or irritate the eye, and when the opportunity occurs it will lend itself easily to any further process of adornment. The drugget will make the best possible background for rugs of rich design, and the shades will perform the same kindly office for the richer curtains when it shall be convenient to buy them. Nothing in the room now will need to be turned out when richer articles are introduced. And this room may be the type of the whole house.

Reliability.

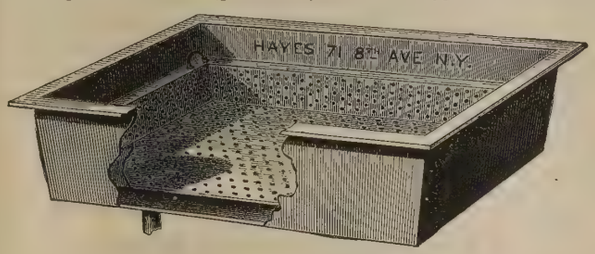
If you are fortunate enough to know a truly reliable man, make him your friend at once, if you can. You can only do so, however, by assimilating his character. The reliable man is a man of good judgment. He does not jump at conclusions. He is not a frivolous man. He is thoughtful; he turns a subject over in his mind and looks at it all around. He is not a partial or one-sided man; he sees through a thing. He is apt to be a very reticent man; he does not have to talk a great deal. He is a moderate man, not only in habits of body, but also of mind. He is not a passionate man; if so by nature, he has overcome it by grace. He is a sincere man, not a plotter or schemer. What he says may be relied on. He is a trustworthy man. You feel safe with your property or the administration of affairs in his hands. He is a brave man, for his conclusions are logically deduced from the sure basis of truth, and he does not fear to maintain them. He is a good man, for no one can be thoroughly honest and truthful without being good. Is such a quality attainable? Most assuredly so. It is not born—it is made. Character may be formed; of course, then its component parts may be molded to the formation. To gain a spotless reputation is a prize worth trying for.

Table Salt an Aperient.—Physicians have for a long time known that common table salt is an efficient aperient in ordinary cases of constipation. In a lecture on a case of nervous affection, Dr. Weir Mitchell, of Philadelphia, said that he had recommended the patient to take each morning on rising a tumblerful of water—cold, to prevent nauseating—in which was dissolved a teaspoonful of table salt. "This simple aperient," the doctor adds, "I frequently employ in cases of constipation, and generally find it efficient. There is great advantage in starting the bowels and in keeping them in a soluble condition, particularly in cases of nervous disorder in women, as it sometimes clears up obscure points in the case, and at all events eliminates one source of error."

A Useful Attachment for Kitchen Sinks.

One of the chronic troubles that periodically arises to plague even "the best regulated families," is the clogging of the waste-pipe connected with the indispensable kitchen sink. Even where the kitchen is under careful supervision, the trouble is sure to come sooner or later; but when, as is generally the case, the care of the kitchen is left entirely to the tender mercies of Bridget or Christine, the frequency of its occurrence need excite no surprise. An attachment to the sink of some simple device that will act as a peremptory check upon careless habits, would save considerable trouble.

We illustrate herewith a very simple attachment of this kind, which manifestly answers the purpose. The cut shows a kitchen sink into which is accurately fitted, making a close joint all around, a tray made of perforated iron (galvanized), brass or copper. This



Attachment for Kitchen Sinks.

tray is so supported as to leave a space between it and the bottom of the sink, to permit the free exit of the strained liquids; and is likewise provided with handles, which permit of its convenient removal for cleaning, and with a box or soap-dish forming part of it.

The object of the attachment is defined to be, to provide for the ready escape of the waste water; to prevent overflowing, arising from clogging at the mouth of the waste-pipe (which in this case may be clear, and not provided with the usual strainer); and to provide an extended filtering or straining surface to catch and retain all solid refuse, leaving it dry on the filter, from which it can readily be removed. The simplicity and utility of the device is too apparent to require further description.

The inventor and manufacturer is George Hayes, Sanitary Engineer, 71, 73 and 75 Eighth avenue, this city. Mr. Hayes will be identified by most of our readers as the inventor of an improved system of skylights, and other appliances associated with the building interest, that bear his name, and which have been described in this journal.

Getting on in the World.

There are many different ways of getting on in the world; it does not always mean making a great deal of money, or being a great man for people to look up to with wonder. Leaving off a bad habit for a good one, is getting on in the world; to be clean and tidy, instead of dirty and disorderly, is getting on; to be careful and saving, instead of idle and lazy, is getting on; to be kind and forbearing instead of ill-natured and quarrelsome, is getting on; to work as diligently in the employer's absence as in his presence, is getting on. In short, when we see any one properly attentive to his duties, persevering through all difficulties to gain such knowledge as shall be of use to himself and others, offering a good example to his relatives and acquaintances, we may be sure that he is getting on in the world. Money is a very useful article in its way, but it is possible to get on with small means, for it is a mistake to suppose that we must wait for a good deal of money before we can do anything. Perservence is often better than a full purse. There are more helps toward getting on than is commonly supposed; many people lag behind or miss the way altogether, because they fail to see the simple and abundant means which surround them on all sides; and so it happens that these means are aids which cannot be bought for money. Those who wish to get on in the world must have a stock of patience and perseverence, of hopeful confidences, a willingness to learn and a disposition not easily cast down by difficulties and disappointments.

Accuracy in Business.

Never make an assertion unless you are positively certain that you are exactly right. Let your reputation be such among your neighbors, that they can depend on anything you say just precisely as you state it. If you sell a pound of sugar, don't give your customer fifteen ounces or seventeen, but just exactly sixteen. We remember in our own experience a man who was certainly not prepossessing, either in appearance or in manners, who had built up a trade which was excelled by none in the town in which he was situated. We wondered at it, and finally asked a friend who traded with the man referred to if he could tell us the secret. "The whole thing," said he, "is that when you buy a pound of meat or a pound of coffee of B., you are certain of getting just exactly what you pay for." That was the whole secret of his success. Make it a habit of being accurate in everything, not only in what you say and in your weights, but in everything you do. Never make a single step until you are sure that is just what you want. Be accurate in your writing. "Dot your i's and cross your t's," is what our school-teacher used to ding into our ears in our boyhood days, and it taught habits of accuracy which we have never had cause to regret. In sending orders to your jobbers, be accurate in them; put down just what you want, and how you want it, in such plain language that you cannot be misunderstood. Be very careful to get your address right—street, number, town, county and state—and you will save a great deal of annoyance at the office where your order is received. In making business engagements, the same care should be shown, and no man who values his reputation will neglect to keep his word good when he promises to receive a call at a certain time, even if the caller is a man with an unreceipted bill.

Precocity a Sign of Inferiority.

M. D. Delaunay, in a communication to the French Société de Biologie, has advanced the opinion that precocity is a sign of biological inferiority. In support of his position, he adduces the fact that the lower species develop more rapidly, and are at the same time more precocious, than those higher in the scale. Man is the longest of all in arriving at maturity; and the inferior races of men are more precocious than the superior, as is seen in the children of the Equimaux, Negroes, Cochin-Chinese, Japanese, Arabs, etc., who are, up to a certain age, more vigorous and more intellectual than small Europeans. Precociousness becomes less and less in proportion to the advance made by any race in civilization—a fact which is illustrated by the lowering of the standard for recruits, which has been made necessary in France twice during the present century, by the decreasing rapidity of growth of the youth of the country. Women are more precocious than men, and in all domestic animals the female is formed sooner than the male. From eight to twelve years of age, a girl gains one pound a year on a boy, and in mixed schools girls obtain the first places up to the age of twelve. The inferior tissues and organs de-

velop before the higher ones, and the brain is the slowest of all organs to develop. M. Delaunay concludes his paper by stating that the precocity of organs and organisms is in an inverse ration to the extent of their evolution.

The Model Foreman.

A man, to be an entire success as a foreman, must make up his mind to be virtually a student for life, and use every means within his power to acquire knowledge. The education of his heart should never be sacrificed to that of the head, but proper discretion should be observed in all cases. While the brain may be overworked by too close application to study, the health should be carefully considered and the physical constitution kept up to a proper standard. A foreman should read upon chemistry, natural philosophy, and the sciences in general. We would also recommend that he read other useful literature, such as histories, narratives, and especially study mechanical drawing, which is indispensable. This course will develop the perceptive faculties, as they are called. He will not discharge a good workman for a slight offense, and retain the poorest men. A good foreman (instead of giving his orders to a man verbally and imperfectly) will always carry a sketch block or pad in his pocket, and, where drawings are not used, will give his orders upon paper, together with a rough pencil sketch, if required. He should then require the workmen to file away those orders, thus putting him in possession of the necessary evidence to defend himself in case there should be any fault with the work when completed.

A foreman should realize that his workmen are entitled to his respect, and he should conduct himself in such a manner that when he moves about among his men they will feel in duty bound to show him all the courtesy which pertains to his position. His personal habits should be such as may with profit be imitated by every man in the shop. If a workman gets into trouble over a piece of work, a kind and sympathetic foreman will always help such a person out of his difficulty.

It is wise for a foreman to use only the best language towards his men, for the use of profanity not only creates an enmity between the foreman and the workman, but also destroys the ambition and interest which the latter should always manifest in his work.

A foreman should be systematic, and wherever a standard or a certain routine can be applied to any branch of the work, it should be done. Tools, instead of being left scattered over the floor should each have a particular place. Thus, both the foreman and workmen are saved the aggravating annoyance of searching for those tools.

When a piece of work is given to a mechanic he should always be allowed to finish it, for one of the most disagreeable things and also one of the most humiliating to the workman is, to commence a piece of work and then have the foreman to take it to some one else to finish.

Finally, a model foreman should endeavor to make himself so useful to his employers that they cannot well do without him, taking the same interest in managing the shop, and studying economy with as much care as if his own capital were invested in the business. The manufacturing world are looking for artisans of this kind, and any person who has followed the opposite plan, will, by adopting the principles herewith outlined, be agreeably surprised in a short time that he can make progress with so much greater satisfaction to himself than ever before.

Fires in New York.

The report of the Board of Fire Commissioners, just printed, shows that during the year 1879 there were in this city 1,551 fires, of which 1,029 were discovered by persons not connected with the Fire or Police Department. In 1,456 cases the fires were confined to the buildings in which they originated. Twenty-five buildings were totally destroyed, and 69 were greatly damaged. Of all the fires, 1,061 were extinguished by buckets of water and fire extinguishers. The total estimated loss by fire during the year was $900,280 on buildings and $4,771,300 on stock, making a total loss of $5,671,580. The estimated insurances on the buildings were $7,276,446, and on stock, $14,525,264, making a total of $21,801,710. The estimated uninsured loss was $180,060. In three cases the loss was between $100,000 and $115,000; in one case $168,908; in one case $352,185; in one case $333,900, and in one case $1,978,991. In 1,066 cases the loss was less than $100.

Nearly a quarter of all the fires were caused by carelessness and 100 are attributed to children playing with matches and fire. Forty fires were caused by the spontaneous combustion of oily rags and other materials, and 93 by exploding kerosene lamps. Four members of the department and 12 citizens died of injuries received at fires during the year, and 139 firemen and 54 citizens were more or less injured.

There are 729 uniformed members of the department. The pay roll of the whole department for 1879 was $1,030,822.14, and the appropriation for all expenses was $1,254,970. The appropriation for the present year is $1,307,670. The department now possesses 233 horses, 1 marine steam fire engine, 58 steam fire engines, of which 5 are self-propelling, 10 chemical engines, 24 hook and ladder trucks, 108 chemical fire extinguishers, and 4 aerial ladders, together with other fire apparatus.

The annual inspection of the department showed that the quickest average time in hitching a team was 3·17 seconds, and in hitching a single horse, 5·66 seconds; The general average of hitching an apparatus was, in 1879, 9·54 seconds; in 1878, 10·26 seconds; and in 1877, 13·03 seconds.

During the year, $30,300 was collected for licenses for the sale of kerosene oil, each license costing $10. The Fire Department Relief Fund now amounts to $422,569.07, and the insurance fund to $12,780.

A Blow at the Nickel-Plating Monopoly.

We record this month with satisfaction, the fact that a recent decision of Judge Blatchford, in the case of the "United Nickel Company *vs.* Pendleton," has broken the backbone of one of the most objectionable monopolies that the eccentricity (not to say stupidity) of the law ever foisted upon the community. The utter want of originality of the Adams patent was all along so obvious to men of science and technologists who were familiar with the contents of the technical journals, that the support which the company that purchased his rights received from the courts, in their endeavor to obtain complete control of the art of nickel-plating in the United States, created the most unbounded surprise, and not a little indignation, for never were claims more thoroughly baseless and impudent carried into a court of law. That the earlier decisions in favor of the United Nickel Company were rendered under mistaken ideas of the nature of the subject, seems now to be proved by the decision against them.

COFFEE PRODUCTION.—It is estimated that the total production of coffee throughout the world, in 1878, amounted to 1,080,975,000 pounds. The greatest consumption of coffee is believed to take place in Holland, where 18 pounds per head of the population are consumed every year; Belgium comes next, taking 9 pounds per head per annum; Norway consumes 8¼ pounds; France, 4¼; Germany, 3; and England only 1 pound.

Miscellaneous and Advertising.

The Knowles Steam Pump Works at Warren, Mass., are rushing business with 150 workmen.

The George Place Machinery Agency, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

Great Britain and Ireland sent out 217,103 emigrants last year, against 147,663 in 1878, and received 53,973 immigrants; 91,806 of last year's departures came to the United States, 17,952 went to Canada, and 40,959 to Australia.

The Maysville (Ky.) Water Company is having built, by the Geo. F. Blake Manufacturing Co., of New York and Boston, a condensing pumping engine of 2,000,000 gallons capacity per diem. Also an auxiliary pumping engine of 1,500,000 gallons capacity. These engines will have to pump against a head of over 350 feet.

The oldest timber in the world, which has been used by man, is supposed to be that found in the ancient temples of Egypt. It is found as dowel pins in connection with stone-work, which is known to be at least four thousand years old. These dowels appear to be of tamarisk or shittim wood (of which the ark is alleged to have been constructed), a sacred tree in ancient Egypt, and now rarely found in the valley of the Nile.

We call the special attention of our readers to the brick manufactured by the Empire State Brick Co., of this city. They are of a very superior product, and possess every quality which good bricks should have; they are handsome in appearance, of perfect shape and have beautiful, sharp and well-defined edges. This company are making these bricks of any sizes, shapes, weight and strength desired, and having every facility to execute orders, are prepared to fill the same promptly.

Design for Cottage Costing $1.000.

We show on the opposite page a very unique design for a cottage intended to accommodate a family of four to six persons. The drawings present unusual variety for a square plan, and the convenience of the interior arrangement must be especially commended.

On the first floor there is a parlor, 12×13.6 feet; kitchen, 10½ × 11 feet; pantry, 3×4 feet; bedroom, 7×7 feet, with closet 2½×3 feet. On the second floor are four bedrooms of the following dimensions, 11½×12, 10½×11½, 5×7 and 7×7 feet. Across the front of the house is a fine piazza, 6×20 feet.

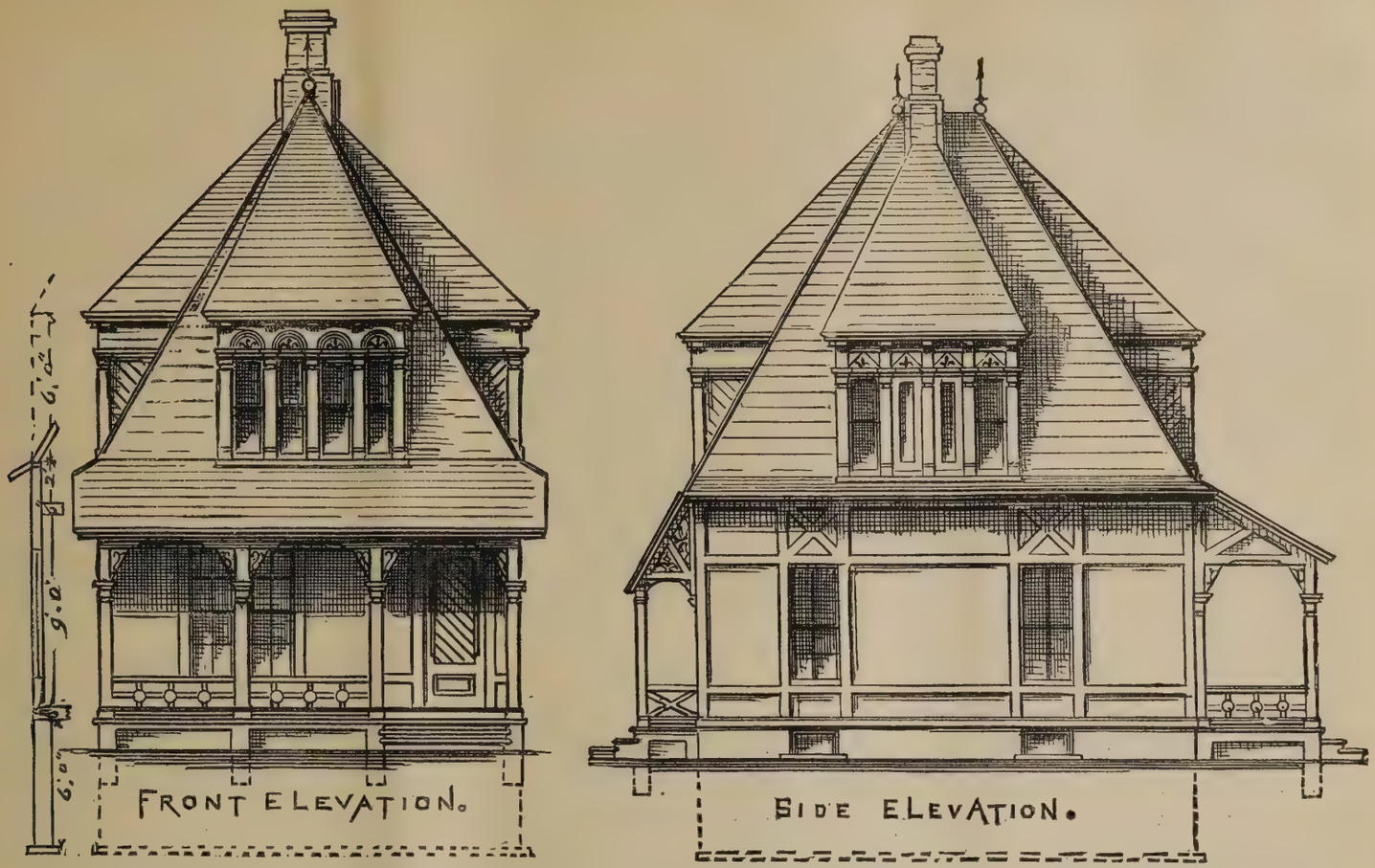
The perpendicular walls are 12 feet high, and weather-boarded horizontally with ⅞×5-inch matched pine boards, with the upper corners of each course beveled ⅜ of an inch. The openings and corners are trimmed with 1¼-inch casing. The roof rises 17 feet from the plates, at an angle of 60°, giving ample air-space over the second story. This story is practically a square one, on account of the width of the dormers, which start from the plates and finish with the second-story ceiling. The roof may be covered with slates, introducing a band or two of color, or either pine or metallic shingles. The gutters, which connect with a 6×6-foot cistern, may be the usual "Yankee" gutters, or half-round galvanized iron gutters, hung under the eaves. The estimate provides for drawing water from the cistern with a No. 2 pump over an iron sink in the kitchen. For the city the pump would not be required, while the usual hot and cold water supply could be made use of, converting the closet space of second-story hall into a bath-room.

The interior walls and roof are lined with water-proof sheathing paper, 18 square feet per pound, and lathed and plastered, without cornice.

The exterior is painted in pearl-gray and lilac, with some strong, rich color in the semi-circular window heads and along the chamfers.

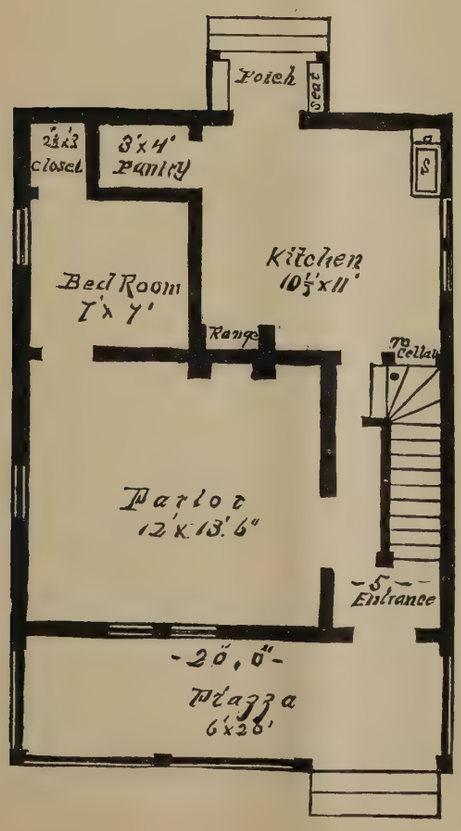
The interior trimmings are of pine, with rule joints and chamfer edged casings, finished with hard-oil finish and varnish.

The architect of this admirable design is Mr. D. T. Atwood, of 335 Broadway, New York.

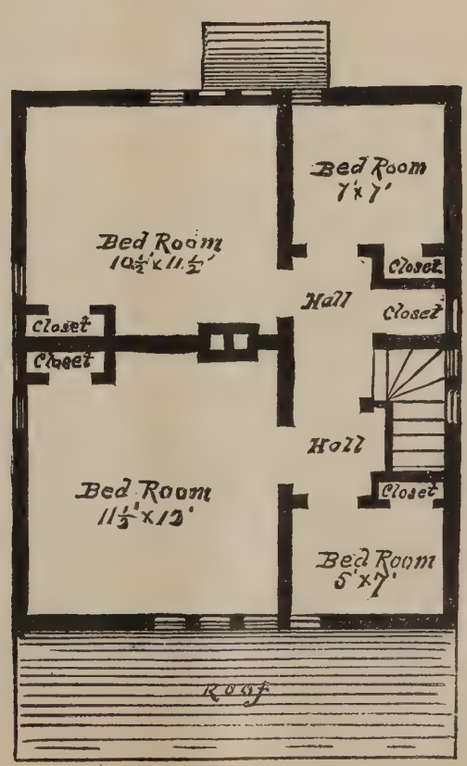


DESIGN FOR COTTAGE COSTING $1,000.

Scale—8 Feet to the Inch.



FIRST FLOOR



SECOND FLOOR.

How Baskets are Made.

The manufacture of baskets, or similar productions from grasses, barks and wood splints, probably antedates the preparation and weaving of fibers into cloths. Mats are used to this day in some of the South Sea Islands as articles of clothing. Basket-making appears to belong to the lower grade of manufactures, and is followed by Indians, gypsies, and persons in civilized communities who have never attained to the employment of mechanical aids of an advanced character. It is one of the industries which seem to belong to the ages when mechanical appliances were of the simplest. But machinery to a certain extent, has supplanted the crude hand-work of the past, and is now employed to advantage in the production of baskets. Unless time were almost valueless, it would otherwise be impossible to produce fruit-baskets, such as are used for berries, at so low a cost as to add scarcely more than a fraction of one cent to the price of their contents as retailed. Formerly every process of producing a basket, from the separation of the splints from the green log by beating with a mallet, to the completion of the utensil, was done by hand. But now little is left for the skill of the hand-worker except the mere weaving of the splints. The limit of material has also been greatly enlarged, the osier finding a rival in the rattan of commerce, and several native woods having been added to the oak, elm and hickory as materials. The core of the rattan has been utilized within a few years to produce excellent work, resembling that of the osier or willow. The outer or silicious portion of the rattan forms the seats and backs of our cane chairs, and its natural luster and surface-finish, with its extraordinary tenacity, have not been equaled by any artificial product. But formerly the core was thrown aside as worthless, as it had lost its rigid and springy quality, and was simply a porous stem, dull on the exterior and considered weak and fragile in substance. Yet some of the most salable baskets in the market are formed of the rattan core. It has a decided advantage over the native or imported osier, in that it may be obtained in greater lengths and more even diameters, and is equally pliable in its entire length. It has no core, or pith—another advantage of considerable importance. These rattan cores are used in basket-making, either whole and round or split. For splint baskets the white or gray oak, and the rock or hickory elm, are most employed, the splints being shaved from a "bolt" or plank of sufficient length to produce the size of basket required and of the proper width. In some establishments these bolts are separated into splints by rolling. The ends of the bolts are scored across the grain with V cuts, and then passed between rollers, when the material splits on the lead of the cuts, making the splints thick or thin, as the scores are made near or further apart. Barrel hoops are formed in this manner. The theory probably is that the outer layers, those nearest the upper and lower rolls, are stretched or expanded by the pressure and released from their fibrous connection with the remaining substance. This idea appears to receive support from the fact that the upper and lower separate splints tend to curve upward and downward as soon as released from the pressure of the rolls. But in some basket-making concerns separation of the splints by means of actual splitting is preferred. In this case the bolt or plank is secured by dogs, just as a log is secured for sawing into boards, and is moved by a sliding frame against the edge of a blade set at an angle in a fixed frame, precisely as the iron of a plane is set. The knife-edge is set out to the required thickness, and the bolt is carried forward by any simple mechanical means, and the splint is shaved off, following the grain of the wood if straight, and diagonally across it if curved. Of course knots and knurls, and curvatures of the grain, and other imperfections, affect more or less the perfection and tenacity of the splint. Unless the splints are very thick, they are formed into baskets in a dry state; but the bottom and top rims, being quite thick, are either steamed in a box or soaked in a tank of water before being worked. All large baskets are made on forms. These are merely shapes of boards or planks of the size and form of the interior of the baskets to be made. For convenience, these forms are suspended in front of the workman by a pivot, so they will turn readily in any direction. All the weaving is by hand, whatever the shape or size of the baskets to be made. When covers are made, they are not usually woven to exact size, but are made of larger area than the top of the basket, placed on it, marked with a pencil, trimmed to size with shears, and then reinforced on the edge with rivets, splints, or hand-winding with flexible rattan.

Iron wire, tinned and annealed, is largely used in modern basket-making. It is employed in the form of staples or rivets, the staples being wound in a lathe on a flat iron bar, as a close-coiled spring would be, and then cut apart by a rotary cutter. The holes for the reception of the staples and rivets are drilled in a machine, and the riveting or clinching is done in a press. Berry baskets are made of whitewood, the veneers of which they are formed being peeled off a cylindrical bolt, as some veneers for cabinet-work are produced. The open sides and solid bottom are formed from one sheet of veneer by dies in a press. A press with dies also forms the basket, the form being secured by rivets. The process is exceedingly rapid.

New Publications.

American Health Primers. "The Throat and the Voice." By J. Solis Cohen, M. D. Price 50 cents. "The Mouth and the Teeth." By J. W. White, M.D., D.D.S. Philadelphia: Presley Blakiston. 1879. Price 50 cents.

Of these numbers of the excellent series of "Health Primers," we can say all that we have said in former reviews, in respect to the thorough scientific accuracy and comprehensible style of treating the subjects discussed, which have made the entire series a model of popular scientific literature. In addition to these general features of excellence, the volumes here referred to have a special interest, in view of the fact that they treat of a set of organs which are particularly liable to derangements and disorders, and which make up a large proportion of the physical vexations of our people.

Dr. Cohen treats his subject under two heads—"The Throat and the Voice." Under the first head we have brief chapters on the following subjects: The General Construction of the Throat; Care of the Throat; Acute Sore Throat; Diphtheria; Croup; Acute Laryngitis; Chronic Sore Throats; Enlarged Tonsils; Foreign bodies in the Throat and Windpipe; Morbid Growths in the Throat and Windpipe; Paralysis of the Throat; Spasm of the Throat; Neuralgia of the Throat; and Naso-Pharyngeal Catarrh. The second treats of the Voice: Acoustics of Voice; Varieties of Voice; the Vocal Organs; Vocal Culture; Improper Use of the Voice; Vocal Gymnastics; Defects of the Voice; and finally, the Care of the Voice.

Dr. White's manual discusses the Anatomy of the Teeth and their Development; the Eruption of Temporary Teeth; Difficult Dentition; Care of the Temporary Teeth; Shedding of the Temporary and Eruption of the Permanent Teeth; Nutrition of the Teeth; Food in its Relations to the Teeth; Constitutional Peculiarities, Varieties and Defects of the Teeth; Tartar, or Salivary Calculus; Decay of the Teeth, or Caries; Toothache; Hygiene of the Mouth; Reparative Treatment, and allied subjects.

Both of these primers are notable for their excellent illustrations.

The Cabinet-Maker and Upholsterer's Companion. Comprising the Art of Drawing, as Applicable to Cabinet-Work; Veneering, Inlaying, and Buhl-Work; the Art of Dyeing and Staining Wood, Ivory, Bone, Tortoise-Shell, etc.; Directions for Lackering, Japanning and Varnishing; to Make French Polish, Glues, Cements and Compositions; with numerous Recipes Useful to Workmen Generally. By J. Stokes. New Edition. Philadelphia: Henry Carey Baird & Co. 1880. Price $1.25.

This book is the fifth edition of what appears to be a very practical and useful manual of instruction and experimental reference to the cabinet-maker and upholsterer's trade. The subject is treated under five headings, or divisions. Part I. contains plain and familiar instructions (with examples) in the art of drawing, with special reference to the requirements of the learner in these trades. Part II. comprises instruction in the processes of veneering, inlaying and finishing in buhl-work, the ornamental decorations used in cabinet-work, describing the best modes of performing this class of work and the materials which experience has proved to be the best for the purpose. Part III. relates to the art of dyeing and staining woods, ivory, bone, etc., together with the processes of gilding and bronzing; giving instructions as to the selection and preparation of materials, and the *modus operandi* of these important processes. Part IV. describes the processes of lackering, japanning, varnishing and polishing articles of cabinet and upholstery work, with instructions and recipes from the most approved sources, for making lackers, varnishes, etc. Part V. treats of glues, cements and compositions for filling up and ornamenting articles of furniture, with numerous selected recipes.

From this *resumé* of its contents, the very practical and useful character of this work to the apprentice, workman and superintendent in the trades to which it refers, may be estimated.

The American House Carpenter. A Treatise on the Art of Building. By R. G. Hatfield, Architect. Eighth edition. Edited by O. P. Hatfield. New York: John Wiley & Sons.

The late Mr. R. G. Hatfield was one of the best authorities upon questions relating to construction, and he gained this position as much from his independent investigation into the strength of materials and of structures as from his knowledge of what had been ascertained elsewhere. Having such wide information, he was qualified to write books on the elements of building, and the success of his "House Carpenter" is simply the result of the intrinsic merits of the book. From its pages a carpenter may acquire all information relating to woodwork that it is possible to give in a book.

It begins with an abstract of the history of architecture, in order to show the relation of the orders of design. Instructions are given for drawing the orders according to one of the ordinary scales of proportion. Mr. Hatfield, in explaining the theory of construction, commences with the laws of pressure and strains, and his method is sufficiently simple to allow of comprehension by men who have not had the help of a preparatory training in mathematics. Throughout this part of the book examples are given which can be worked out in figures. A book on carpentry would be unworthy of the title unless the mysteries of setting out hand-railing were elucidated. Mr. Hatfield is sufficiently explanatory for all cases that are likely to present themselves, and his method is not difficult. The second part of the book treats of mathematics, including arithmetic, algebra and geometry. Mr. Hatfield's book is, in fact, as good as a small library to the house carpenter.

Fresh-Water Rhizopods of North America. By Joseph Leidy, Professor of Anatomy, University of Pennsylvania. 324 pp., 4to, with 48 colored plates. Being Vol. XII. of the 4to series of Reports of the United States Geological Survey of the Territories. F. V. Hayden, Geologist-in-Charge. Department of the Interior, Washington: Government Print. From Dr. F. V. Hayden.

This long-expected work of Dr. Leidy is a splendid contribution to the already very valuable series of publications that have made the United States geographical survey under Hayden's direction known wherever science is appreciated. The book is magnificently illustrated with numerous colored plates, and represents the laborious study of years on the part of the author. It presents the results of a vast amount of careful microscopic research respecting the structure, development, habits, etc., of an important, and thus far little known, class of beings which constitute the lowest forms of animal life.

Water-Analysis for Sanitary Purposes; with Hints for the Interpretation of Results. By E. Frankland, Ph.D. Philadelphia: Presley Blakiston. 1880.

Prof. Frankland is one of England's most prominent chemists, whose services have repeatedly been called into requisition by the government and local authorities of his country, in the investigation of important subjects relating to sanitary science. Aside from his eminent reputation as a chemist, therefore, the publication over his name of a book on the subject of water analysis, with which his extensive experience has made him specially familiar, would be of itself a sufficient guarantee of its value, both to the student and the expert analyst.

OTHER PUBLICATIONS RECEIVED.

Patent Soliciting and the United States Court Practice at Howson's Patent Offices, No. 119 South Fourth street, Philadelphia. From Howson & Son.

Report of the Board of Commissioners Seventh Cincinnati Industrial Exposition, 1879. Published by order of the Board. Cincinnati, O.: Times Book and Job Printing Establishment. 1880.

Report of the New York State Survey for the Year 1879. James T. Gardner, Director. The Niagara Falls Reservation. Albany: Chas. Van Benthuysen & Sons. 1880. From the Director.

Bulletin of the United States Geological and Geographical Survey of the Territories. F. V. Hayden, U. S. Geologist-in-Charge. Vol. V., Nos. 2 and 3. Washington: Government Print. 1879. From the Department of the Interior.

A Catalogue of the Forest Trees of North America. By Chas. S. Sargent, Arnold Professor of Arboriculture in Harvard College, Special Agent Tenth Census. Washington: Government Printing Office. 1880.

Immigration; its National Character and Importance to the Industries and Prosperity of the Country. Speech of Hon. Levi P. Morton, of New York, delivered in the House of Representatives, Thursday, April 22d, 1880. Washington.

Condensed Treatise on the Manufacture of Sugar from the Beet Root, as well as from Sorghum and Corn-Stalks. By Mauricio M. Monsanto, C.E., Graduate of the Polytechnic School of Hanover, Germany. Jersey City: Evening Journal print.

Summary Statement of the Imports and Exports of the United States for the month ended February 29th, 1880, and for the eight months ended the same, compared with the corresponding periods of 1879. Washington, D. C.: Bureau of Statistics.

Summary Statement of the Imports and Exports of the United States for the month ended March 31st, 1880, and for the nine months ended the same, compared with the corresponding periods of 1879. Prepared and published by the United States Bureau of Statistics. [Corrected to May 7th, 1880.]

Bulletin of the United States Entomological Commission. No. 1, Destruction of the young or unfledged locusts; No. 2, On the natural history of the Rocky Mountain locust, etc.; No. 3, The cotton-worm, etc., by Chas. V. Riley, Ph.D.; No. 4, The Hessian fly, etc., by A. S. Packard, Jr., M.D.; No. 5, The chinch bug, etc., by Cyrus Thomas, Ph.D. Washington: Government Print. From the Department of the Interior.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2640) Gilding Silver without a Battery.—Please inform me how I can gild silver without a battery.—A. B., Jersey City, N. J.

(2641) To Weld Horn or Tortoise-Shell.—Can you inform me how pieces of horn or tortoise-shell may be joined or welded?—F. R. W., Newark, N. J.

(2642) To Silver Ivory.—Will you be kind enough to give a formula for silvering ivory.—F. R. W., Newark, N. J.

(2643) Measuring the Intensity of Light.—Will you inform a reader of your journal what is meant by the term "candle power," and how it is determined. I see the term used in connection with electric light tests, but do not quite understand how a uniform standard of comparison can be based on the light given out by a candle; but perhaps this is because I do not understand the subject sufficiently.—F. P., Dover, Del.

(2644) Electrical Motors for Blowing Organs.—Are there any electrical motors in practical use for blowing organs? If so, where?—F. E. B., Peterborough, Canada.

(2645) To Deaden Sounds.—What light, cheap substance can I put in an inner wall of lath and plaster to deaden sounds from one room to another? What do melodeon manufacturers use for the same purpose—that is, for the tuners' rooms?—F. E. B., Peterborough, Canada.

(2646) Quantitative Analysis by the Spectroscope.—What success has been met with in the use of the spectroscopic method for quantitative analysis? I have seen notices of experiments to perform the assaying of the precious metals used in coinage, by means of the spectroscope, but have nowhere seen an account of the value of the method for practical purposes. I will be obliged to you for information on this point.—A. J. P., Reading, Pa.

(2647) Choice of Pursuit.—My son is nearly sixteen, and wants to go to college. He has passed through the common schools of our town, and I want him to get down to a trade. I have a machine shop, and have always wanted him to be a machinist. I have seen a number of cases where boys have got so high flown in their ideas by going through college, that they thought themselves too good to become greasy mechanics, or to learn other good trades, and they did not amount to much after all. I am afraid college will put too much nonsense in the boy's head, and that he may come home thinking his father's trade is not good enough for him. What do you think about it?—J. H. C., Bennington, Vt.

(2648) Bending Glass Tubes.—I am a regular reader of your journal, and like your answers to correspondents so well, that I thought I would take the liberty of asking you a question on my own account about a matter that troubles me some. I like to experiment in chemistry after a fashion, and find great difficulty in bending glass tubes so as not to "kink." With narrow tubes I have not so much trouble, but wide ones I can do nothing with, as the under side—that is, the inside of the bend, is bound to be kinked, so much as to often half close the tube. How can I avoid this? Another thing, I find often after considerable heating, my glass becomes of a grayish-white, and quite opaque at the heated part. I think the quality of the glass has something to do with it. Is this so?—L. R. J., Titusville, Pa.

(2649) Silk Culture.—Please inform a reader in your next, where the culture of silk originated, and when it was first introduced in Europe.—N. G., Stamford, Conn.

(2650) Koumys, or Milk Wine.—I have been told that a very pleasant, sparkling beverage, possessing very nourishing qualities, is prepared from milk. Can you tell me how it is prepared?—S. W., Sacramento, Cal.

(2651) Infusorial Earth.—Can you inform me what infusorial earth is used for? and by so doing oblige.—C. W. McK., Petersburg, Va.

(2652) To Restore Faded Writing.—Can you inform me of a method for restoring, or at least rendering more legible, the writing of faded manuscripts?—F. A. G., Jr., Terrahaute, Ind.

(2653) To Make Plaster of Paris Non-Porous.—Can you give me a recipe for making plaster casts non-porous?—W. J. W., Jacksonville, Fla.

(2654) Ancient and Modern Mortars.—How is it that ancient mortars are so much better than our modern material? Had our forefathers a secret that we have lost?—R. T., Milwaukee, Wis.

(2655) Gas Engines.—I want to know something of the economy of the gas engine, and what powers are built. Your reply will oblige.—G. G., Toledo, O.

(2656) Trouble with a New Cistern.—I have lately had a cemented cistern made, but find the water has a very strong and disagreeable taste. I have had the water pumped out several times and the cistern refilled, but without much improvement. Can you suggest any remedy?—E. E. T., Cape May, N. J.

(2657) Removing Hard Putty.—Is there any way of lessening the trouble of removing hard putty from window-sash? If so, I will thank you for suggesting it.—G. A. McC., Downingtown, Pa.

REPLIES.

A Medical Question.—M. E. G., of East Liverpool, Ohio, sends us a description of a physical ailment from which he is suffering, the details of which it will be unnecessary to give, since the editor of this journal, not being a member of the medical fraternity, does not consider it proper for him to offer medical advice. We have laid down the rule, therefore, to decline to answer queries of this nature, for the reason above given, which, we are sure, M. E. G. will regard as a valid one.

(2630) Problem of a Marching Column.—The types committed us to an error in our solution of this interesting problem, which our mathematical readers have doubtless seen, and attributed it to its proper cause—a typographical error. We correct it herewith. In combining equations at the first separate line, instead of

$$\frac{375-15x}{x}\times 2\times -15=50,$$

the equation should read $\frac{375-15x}{x}+2x-15=50$

(2640) Gilding Silver without a Battery.—Gilding metals without a battery can be effected either by the amalgamation process (generally called fire-gilding), or by dipping. Our inquirer will find a very full and clear description of the process of fire-gilding in our issue for March, 1876, page 71, to which we refer him. For gilding by dipping, there are a number of methods. One is given on page 216 of our September number for 1878, though, as it involves the production of the very explosive compound known as "fulminating gold," it must be used with great caution to avoid accidents. Another procedure is as follows: The gold bath should (best) have the following composition: Distilled water, 17 pints; pyrophosphate of soda (obtained by heating to fusion the ordinary phosphate of soda of the shops), 28 ounces; hydrocyanic acid (prussic acid) of 12 per cent strength, ½ of an ounce; crystallized per-chloride of gold, ⅗ of an ounce. This quantity of gold represents about ½ of an ounce of metallic gold. Dissolve the pyrophosphate of soda in about 16 pints of the water, with the aid of gentle heat, stirring with a glass rod, using a porcelain or porcelain-lined vessel for the purpose; then filter and allow it to cool. Prepare the gold chloride by introducing into a porcelain dish or glass flask ½ of an ounce of finely laminated or precipitated gold in powder, 1 ounce of strong hydrochloric acid, and ½ ounce of strong nitric acid. On applying gentle heat, the gold will speedily be dissolved with the evolution of nitrous fumes, leaving a reddish-yellow liquor. The heating should be carefully continued by means of a gas or spirit lamp, to drive off the excess of acids (which if allowed to remain, would seriously interfere with the action of the bath). An excess of heating, on the contrary, must be avoided with equal care, as the result will then be to reduce a portion of the gold, and will require an additional treatment with acids. The evaporation is finished when the vapors escape very slowly from the flask and the liquid has attained an oily consistency and a deep red color. The flask or dish is then set aside to cool and crystallize. When properly prepared, the gold chloride forms a saffron-yellow crystalline mass. If it is too red in the color, it has been over-heated, and must be again treated with a trifling quantity of the acids and again gently heated. When the gold chloride thus prepared has cooled and crystallized, dissolve it in the dish or flask with a little distilled water, and filter the solution through a paper filter into a clean glass flask, washing the filter thoroughly with more of the distilled water, to wash out all the gold. Then pour the clear gold solution into the previously prepared and cold pyrophosphate solution, rinsing out the flask with the balance of the reserved distilled water, that no gold may be lost. After stirring thoroughly with a glass rod, add the hydrocyanic acid. The bath is now finished, and when required for use, should be heated nearly to the boiling point. The addition of hydrocyanic acid, though not absolutely necessary, is nevertheless advantageous in preventing the decomposition of the bath and the too rapid precipitation of the gold on the objects dipped. The bath should have a yellowish or greenish-yellow color when cold, and should become colorless on heating. If it becomes reddish on heating, add a few drops more of hydrocyanic acid, until it becomes colorless. A little experience will teach how to correct any irregularity in the bath, whether it results from too much gold or too much acid; a slight addition of hydrocyanic acid will correct the first, and a slight addition of prussic acid the last. Thus prepared, the bath will produce a very fine gilding on well-cleaned metallic objects, which, however, must first be passed through a very diluted solution of nitrate of mercury, which prevents the deposit from being irregular. The silver articles are then suspended in the gilding bath, kept at the boiling point (or nearly so), and retained therein until the covering appears to be sufficiently deep. The gilders, it is said, prefer to use two, or even three baths, the first being nearly spent, the second not so much spent, and the third of regulation strength, passing the articles to be gilded, in succession, from one bath into the next, beginning with the weakest. These baths are arranged side by side, and heated from the same source of heat. In coating silver with this gilding solution, it is also recommended that a slight excess of acid be used. The deposit is fine, but lacks the firmness of fire-gilded work. It is scarcely necessary to add that hydrocyanic acid is a deadly poison, and must be handled with extreme precaution.

(2641) To Weld Horn or Tortoise-Shell.—Workers in horn and tortoise-shell are provided with pincers or tongs of different sizes and forms, so that when applied to the joint to be made, the tool reaches considerably beyond the joint—say three or four inches. The edges to be joined are filed to a bevel or lap-joint, care being taken to have them quite clean and free from grease. The edges are joined after wetting with water, the pincers are applied hot, and followed with water. By this procedure the horn or shell will be found to be joined as though it were one piece.

(2642) To Silver Ivory.—For silvering ivory, we give the following formula, which we believe is generally used for this purpose: Make a solution of nitrate of silver in distilled water—common well or hydrant water will not answer as well, as the solution will generally be clouded from the precipitation of chloride of silver—and immerse in it the piece to be silvered. If some ornamental design in silver is desired, then cover the ivory with a thin coating of wax, through which trace the design with some suitable instrument that will remove the wax but not scratch the ivory; then immerse the piece in the solution as before. Leave the ivory in the silver solution until it has turned of a deep yellow, then remove, wash well with water, and expose it to the sun, wetting it from time to time with water. The parts affected by the solution will shortly turn black, by reason of the reduction of the silver, and if then well burnished will assume a brilliant silvery luster.

(2643) Measuring the Intensity of Light.—This inquirer's questions are very natural and pertinent, and his doubt whether a uniform basis of comparison of intensity of light can be afforded by the light of a candle, is a very proper criticism. Nevertheless, this is the standard of comparison employed in all light measurements; and to reduce the variation in the amount of light given out by the "standard candle" to the lowest possible minimum, it is made of nearly uniform composition as can be attained. The "standard candle" light referred to in photometric tests, is the light given out by a sperm candle burning 120 grains per hour; and in actual photometric tests the candle is weighed before and after the test, to obtain its luminosity at the above-named rate of consumption. Even with this precaution, however, the *standard* candle is not so desirable a standard as could be wished. Its luminosity is not strictly constant, and hence the results of photometric tests based upon it are only approximately accurate. It is probable that, sooner or later, the suggestion made by Prof. Draper will be adopted—to use, in place of the standard candle, a strip of platinum of given weight and surface, heated by an electrical current of given strength. This would give results strictly correct and reliable. As to the manner of determining "candle power," we refer our inquirer to the numerous text-books on physics, where the construction of various forms of photometers, and the methods of using them, are set forth and explained at length, only remarking that the photometer of Bunsen is the instrument that is generally used.

(2644) Electrical Motors for Blowing Organs.—We know of none in use for the purpose our correspondent names. If any of our readers are better informed, we would be pleased to hear from them for his benefit.

(2645) To Deaden Sounds.—We do not know that melodeon manufacturers have any *special* method of deadening their tuners' rooms. The plan commonly in use for floors, is to lay a floor midway in the joists, then a few inches of good lime mortar, in which the floor is put down as usual. Instead of this, a filling of mineral wool or wood shavings and sawdust, or dry peat where the latter is obtainable, may be used. Mineral wool, or the last-named means—sawdust or peat—will be equally serviceable for partitions.

(2646) Quantitatite Analysis by the Spectroscope.—Experiments to use the spectroscope for quantitative analysis have been undertaken specially with the view of employing it for the assaying of the precious metals, and they have naturally emanated from the scientific departments of the mints. Such experimental attempts have been reported from W. C. Roberts, of the London mint, and A. E. Outerbridge, of the Philadelphia mint, and the results in both were unsatisfactory, so far as establishing a practical working method is concerned In both cases, the principle which formed the basis of the experiments, was that first noticed by J. Norman Lockyer, a celebrated English spectroscopist, "that when a powerful induction coil is used, and the distance between the metallic electrodes is gradually increased, certain of the lines of the spectrum break in the middle; and that on further increasing the distance between the electrodes, the hiatuses in the spec-

trum lines increase proportionally, until the lines themselves finally disappear." Mr. Outerbridge, whose experimental investigations of this subject were very exhaustive, found, in his attempts to found a working quantitative method of analysis on Lockyer's discovery, that the method was defective in the extreme. He reports that the differences between the spectra of two alloys of considerable difference in constitution, were very slight; and where the alloys approached closely in composition, the spectral differences were quite unappreciable. A difference of one-1000th, for example, required an effort of the imagination to detect. The amount of metal vaporized was found to be too infinitessimal to give safe results on a large scale, since these results would be likely to be vitiated by the slightest want of homogeneity of the alloy. This point will be appreciated when it is stated that the quantity of metal vaporized by each spark was found not to exceed the one-1,000,000th of a grain. Finally, Mr. Outerbridge found that while the spectroscope was very sensitive to pure metals, a comparatively large quantity of gold could be present in an alloy, and the spectroscope would not indicate its presence. In an alloy of gold and copper, for example, containing from 200 to 250 parts of gold, the spectrum of gold is scarcely visible; and this same want of sensitiveness holds good of other metallic alloys. On these grounds, Mr. Outerbridge has pronounced the use of the spectroscope for assaying to be impracticable.

(2647) Choice of Pursuit.—Our opinion would depend very much on the kind of boy he happened to be. If he has an adaptability and liking for mechanical work, which you as his father ought to make sure of before you oblige him to take up your trade, then, if you can afford it, a course at one of our good schools of mechanical engineering would be of immense advantage to him. As to college, for a boy intended for a mechanical trade, we venture the opinion that the very impractical and general kind of cultivation he would get there, would be of little service compared with the usefulness of a technical school that we suggest above; and unless the boy was blessed with good common sense—a rare commodity—it might, as you fear, develop the form of "softening of the brain" that you have noticed in other cases, and of which disease we have also seen numerous examples. On the other hand, if the boy is bright and ambitious with no taste or liking for a manual trade, it might not be the best for his future to compel him to learn a trade that was distasteful to him, and, if it is within your means, a college training would form an excellent culture as the foundation for some professional pursuit—law, medicine, or the like. It is as much a mistake to force a bright boy against his tastes and inclinations, as it is to suppose that a college training necessarily makes him a "snob." Educated hogs may be seen almost anywhere, without visiting the managerie to find them. But it would not be fair to accuse their college training for their uselessness and general offensiveness. This genus is mainly recruited from the ranks of rich men's sons, who have imbibed the unfortunate notion that there will never be any necessity for them to do anything useful; and for this very common condition of things, the lack of sensible home training is chiefly responsible. Here college training has simply put a superficial veneering on a spoiled lot of goods—but the goods would have been the worse without it. You know your boy, his inclinations, and—making due allowance for your partiality as his father—his talents, and from the very sensible tone of your letter, we do not think you will make a serious mistake in deciding what is best for him. But since you ask us what we think about it, we will say again, supposing the boy to have no disinclination to your trade, a course at a good school of mechanical engineering, where theory and practice go hand in hand, would be of invaluable service to him hereafter.

(2648) Bending Glass Tubes.—The trouble of bending glass tubes properly is one of the first difficulties that the amateur experimenter in chemical manipulation meets with. Like most other simple things, it is quite easy when you know how to do it. The trouble with our inquirer, is that of most beginners in glass-working. He probably does not heat his glass evenly all around, but over-heats the side towards which he bends the tube, so that in bending, this being the softest side, it gives way, or "kinks," as he has it. In addition to this, he may probably heat the glass too hot before bending, which would have a tendency to the same result; and unless he uses a glass-blower's compound lamp, which gives a broad, flat flame, he most likely heats only a narrow circle of the tube. Either of these faults, or all combined, will give rise to the trouble our correspondent complains of. To remedy it, we give him the following hints: 1. In putting a glass tube in the flame, say a Bunsen burner, keep it rotating slowly, but uniformly, all the time it is in the heat. By this means it becomes evenly heated and uniformly soft all around the heated part. 2. Heat as broad a space of the tube as your flame will permit. With a Bunsen burner this will require moving the tube laterally to and fro, keeping up the rotary movement, however, all the time. 3. Do not heat the tube too hot. This is a very common mistake. Unless the tube has very thick walls, it does not require to be heated even to dull redness before it can be easily bent to any angle. A little trial will suffice the operator to feel that the tube gives on slight pressure, and when that is the case, remove the tube from the flame and bend it to the required angle, slowly and steadily. By observing these simple rules, our correspondent will have no trouble at all in making a perfectly round bend on tubes of moderate size, such as are required in most chemical manipulations. Tubes of large bore, or of very hard glass and thick walls, present special difficulties. These should first be filled with fine, dry sand, and closed, so as to prevent its escape (though not so tight as to prevent the escape of the confined air). The heating and bending should then be done as above. The sand offers an equable support to the walls of the tube, and this prevents the collapse of one side. With regard to the glass becoming opaque on being heated, this is due entirely to the quality of the glass. It is a common source of trouble with glass containing much lead in its composition. The lead, which is present as silicate, is decomposed in the reducing portion of the flame, and separates out, probably as an oxide. Such glass is unfit for laboratory purposes, and should be rejected.

(2649) Silk Culture.—The actual birth-place of the silk industry is lost in remotest antiquity. Like many of our most useful and beautiful arts, it probably originated in China. The first authentic historical record of silk culture carries back its date to 1703 B.C., although the Chinese records carry its origin as far back as 2700 B.C. From China, silk production extended at a very early period, and in Annam, Cochin-China, Burmah and Northern India, silk culture became an established industry long before the Christian era. From these countries, the raw silk found its way into Persia, Arabia, Syria, Egypt, and at length, before the time of Aristotle, into Greece, where it was manufactured into robes and garments for kings and princes. The secret of producing the silk was kept a close secret for many centuries, and the Greek and Syrian cities which imported the raw silk, were compelled to pay so high a price for it, that their silk fabrics were sold ounce for ounce for their weight in gold. The manner of the introduction of silk culture into Europe is generally believed to have been as follows: The Roman Emperor Justinian is said to have received the secret from two Nestorian monks, who had been for several years missionaries in China, and who presented themselves before the emperor in the year 555 of our era, showed him a quantity of silk-worm eggs, which they had brought concealed in the hollow of their pilgrim's staves from China, and revealed to him the entire process of silk culture, which they had carefully observed. Under Justinian's direction the culture of silk was rapidly and systematically extended over a considerable portion of the Roman dominions; and in Asia Minor (which is now European Turkey), Sicily, Greece, and other countries, the raising of silk became a favorite employment, and, somewhat later, in Italy and Spain. In France the manufacture of silk goods long preceded the culture of the raw product. Silk was woven at Tours and Lyons certainly as early as the thirteenth century; but the first attempts to grow the silk were not made until the time of Louis IX., in 1480, and the culture was not really established in France until the year 1603, during the reign of Henry IV. Many countries, as our correspondent is doubtless aware, in which the manufacture of silk goods is carried on extensively, are not silk growers. This statement will hold good of our own country, where silk goods to the value of many millions of dollars are annually produced from raw silk imported from China, Japan, France, and other countries. A systematic effort is now being made, however, under the auspices of the Women's Silk Culture Association of the United States, to domesticate the cultivation of silk in this country.

(2650) Koumys, or Milk Wine.—This inquirer doubtless refers to the so-called "Koumys," or milk wine, that has of late been much extolled in the medical journals as an excellent remedy for digestive troubles and general debility. The original "koumys" is a drink prepared by the Tartars from the milk of mares, by fermentation with a home-made yeast. Several recipes are given for the preparation of a similar milk wine from cows' milk, of which we herewith give one of the best: Take of grape sugar ½ an ounce and dissolve in 4 ounces of water; in about 2 ounces of milk dissolve 20 grains of Fleischman's compressed yeast (or of well-washed brewer's yeast). Mix the two in a quart champagne bottle, which should then be filled with good cow's milk to within a couple of inches of the top; cork well, securing the cork with wire or a string, and place in an ice-chest or cellar, at a temperature of about 50° Fah., or lower, and agitate three times a day. In three or four days the koumys is ready for use, and should not then be kept longer than four or five days. It should be drawn with a champagne tap, so that the carbonic acid gas may be retained. Made after this recipe, koumys is described as a rich, creamy, homogeneous liquid, slightly acidulated, foaming like good soda water, of an agreeable taste, and possessing admirable nourishing qualities, being retained by invalids when the stomach rejects everything else.

(2651) Infusorial Earth.—Answering this inquirer, we beg to inform him that infusorial earth serves a variety of useful purposes. Its most important application—that which consumes the largest quantity—is in the manufacture of giant powder or dynamite, which is simply infusorial earth saturated with as much nitro-glycerine as it will carry. Similarly it is used as an absorbent of other liquid products—such as carbolic acid, bromine, chloride of zinc, and other disinfectants. It is a good non-conductor of heat, and, where it is cheap enough for the purpose, is used as a heat-insulating lining for ice-houses, etc. It has also been suggested for fire-proof safes. It has been used in the manufacture of artificial stone (see Ransome's English patent), and in the preparation of cements in combination with different substances. For example, one formula is: Infusorial earth and litharge, equal parts; slacked lime, ⅓ part; mixed to paste in linseed oil. Another is: 6 parts of the earth and 1 of lime, intimately mixed by grinding with a little water. The resulting product may be pressed into molds, and becomes very hard. A mixture of infusorial earth and sulphur is known by the name of "Zeiodelite." A German cement called "Albolite," is a combination of the earth with carbonate of magnesia. It has been used in making a "hot-cast" porcelain by fusion with stassfurtite, a natural borate of magnesia. With tincalzite, or boro-natrocalcite, it makes what is said to be a good glaze for enameling iron vessels, slate, etc. It has been tried in the manufacture of glass in place of sand, and in the manufacture of soluble glass. It is sometimes added to sealing-wax, to prevent it from running; and to paper to give it body; to soap for the same purpose; and to molding-clay to prevent it from cracking. From the above enumeration, which is doubtless incomplete, our correspondent will observe that the applications of infusorial earth are both numerous and varied.

(2652) To Restore Faded Writing.—If the ink of the manuscripts is an iron-ink, which, if the writing is very old, it is likely to be, it can be very much improved by first moistening the paper with water, and then immersing it for a short time in a weak solution of ammonium sulphide. The ink becomes black almost immediately, for the reason that the sulphide unites with the iron present in the written characters, and transforms it into a black sulphide of iron. The paper should be washed by a brief immersion in water to remove the excess of ammonium sulphide present in the paper, and then dried, when the legibility of the written characters will be found to be very much improved. If the ink is not an iron-ink, we can give you no suggestion, except you could state just what its character is.

(2653) To Make Plaster of Paris Non-Porous.—Several plans for this purpose have been suggested, all of which are of the nature of subsequent applications after casting. The simplest, we think, is the plan of warming the object and applying melted paraffin or stearin until a water-repellant surface is obtained. It will not do, however, to expose such prepared casts to the heat of the summer sun, as the heat will be sufficient to melt it, or to soften it so much as to afford the dust a good lodgement on its surface. A better plan is that of Dr. Reissig, of Darmstadt, who was awarded the prize offered some years ago by the Prussian Minister of Commerce for a method of preparing plaster casts so as to permit of their being washed. The object, as announced, was to obtain a surface which should not dissolve in water, and which should prevent dust from entering the pores. Dr. Reissig's process is described to consist in the application of a water-glass solution (silicate of soda or potassa), by which the surface of the cast is converted into a silicate of lime, a considerably harder compound than the original plaster surface. This application, however, does not render the surface imperious to moisture and dust, to accomplish which, he makes a subsequent application of an alcoholic soap solution. This gradually evaporates and leaves a layer of the soap filling up the pores.

(2654) Ancient and Modern Mortars.—It is doubtless true that in hardness and binding qualities, the ancient mortars surpass the modern; but the supposition that this superiority is to be ascribed to certain secrets of manufacture, or of manipulation, which in our day have been lost (although this assertion is sometimes made), is purely gratuitous. The true explanation, without doubt, is that *all mortars improve as they age*, and attain their maximuum hardness and strength only after a very long time. This is accounted for by the fact that a chemical union takes place between the lime and the silica of the sand composing the mass, and this is an extremely slow process, requiring years to complete. Comparative examinations of ancient and modern mortars, show that the older the mortar the more silicate of lime it contains, and consequently the better its quality.

(2655) Gas Engines.—The economy of the gas engine comes out most prominently where the work required of it is intermittent in character. It wastes comparatively little when not at work, the governor cutting off the gas supply down to the quantity required to turn the engine. We have been informed that in localities where gas is to be had at reasonable rates, these engines will compare vary favorably with steam engines in point of economy, and will considerably surpass the steam engine for many forms of duty where the work is irregular or intermittent, as above noticed. We do not know what the largest engines of this kind built have been rated at, but know of gas engines in use in Germany that are rated as high as 50 horse-power.

(2656) Trouble with a New Cistern.—The trouble of our correspondent is a very common one, which appears to be impossible to avoid with freshly cemented cisterns. It is due to the uncombined lime of the cement dissolving in the water, to which it imparts of strong alkaline flavor. With some species of cement, this trouble is doubtless more aggravated than with others. But in any case, it will cure itself in time. If the trouble is very aggravated, it might be well to thoroughly stir into the water a pound or two of silicate of soda, or of carbonate of soda, and let it remain a day or two. Then pump out clean several times. This application will hasten the combination of the free lime, and may be found serviceable.

(2657) Removing Hard Putty.—Hard putty, it is said, can be removed from a window-sash with great readiness by simply applying a piece of heated metal, such as a soldering-iron or other similar instrument. When heated—but not red-hot—the iron is to be passed slowly over the putty, which is thereby rendered so soft as to be easily parted from the wood.

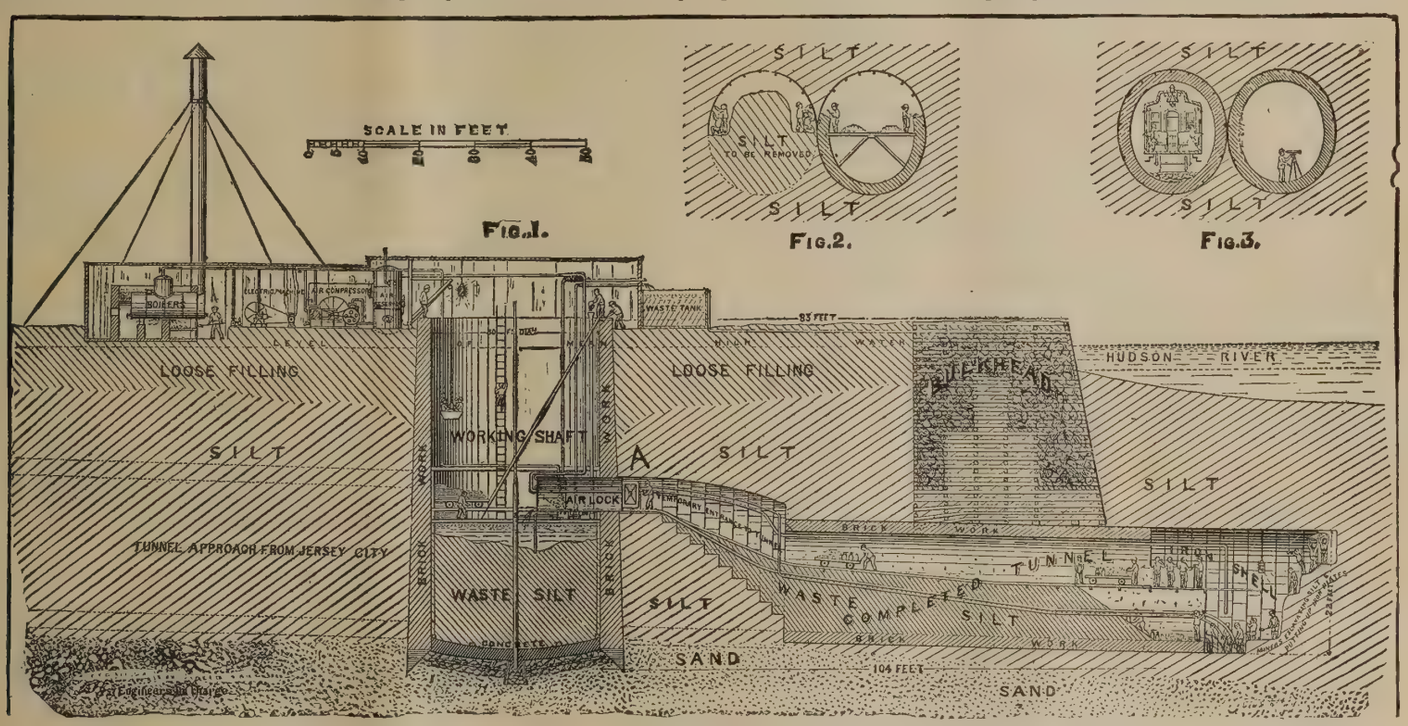
THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 8. AUGUST, 1880. TWELFTH YEAR.

The Hudson River Tunnel Disaster.

Early on the morning of Wednesday, the 21st of July, there occurred a cave-in on the line of the Hudson River tunnel, by which the lives of twenty men were sacrificed. Our readers have doubtless read the accounts given in the daily papers, and will have obtained from these a general idea of the cause of the accident. On this point we have a few comments to add. The immediate cause of the accident will be understood by reference to the annexed engraving, which gives a sectional view of the working shaft, the air-lock, the connecting passage where the cave-in occurred (indicated in the engraving by the letter A), and the tunnel proper. The latter had been driven several hundred feet from the working shaft without serious accident, but owing to the hazardous condition of the temporary entrance, through which the men were obliged to pass on entering and leaving the tunnel, work on the tunnel proper had been suspended, and the men were set to work on this connecting passage, with the object of completing the permanent tunnel back of the shaft, when the accident occurred by the starting of a leak at the joints of the iron plates uniting the roof of the connecting tunnel with the brick-work of the working shaft. The soil above the place of the accident was known to be not so solid as that encountered further on in the tunnel proper, much of it being made ground, or loose filling; and it had been rendered still more loose and porous by having been disturbed in the sinking of the working shaft. Several leaks more or less threatening, it is said, had occurred thereabouts, but up to the time of the accident nothing serious had happened in consequence of the vigilance of the workmen, who had succeeded in stopping the escape of the compressed air and the caving in of the tunnel by plastering the leak with a few shovelfuls of silt, or fine pasty mud, which chiefly forms the stratum through which the tunnel is being driven. When the tunnel was first started from the shaft, it is reported that much difficulty was met with in preventing the escape of the compressed air used in working, on account of the porous nature of the soil of the river bank; and this was only obviated by burying large sheets of canvas several feet below the surface of the ground. The accident occurred in this stretch of porous ground.

By reference to the accompanying engraving, the nature of the work, the extent to which it had progressed, and the locality of the accident, will be made clear. The work on the tunnel was begun by sinking the "working shaft" 100 feet from the river, at the foot of 15th street, Jersey City. This shaft is 30 feet in diameter and 65 feet deep, and is lined with a brick wall 4 feet in thickness. The way to the temporary entrance to the tunnel was through the air-lock, shown in the engraving, which is a chamber of stout boiler-iron, 6 feet in diameter and 15 feet long, provided with air-tight doors in each end. A railway track through the lock served for running small cars loaded with bricks and other materials, into the temporary cut and the tunnel. When the men were sent into the tunnel, they entered the air-lock and closed the door behind them; an air-cock was then opened, communicating with the tunnel, until the pressure in the lock was nearly the same as in the tunnel, and then the men opened the second door and passed into the temporary cut. On leaving, they entered the lock, and an air-cock communicating with the outer atmosphere was opened to relieve the pressure, when the outer door leading into the working shaft could be opened. Both of the air-lock doors opened toward the tunnel, so that the pressure from within would tend to keep them shut, and the men inside the tunnel would not be subject to danger by the doors bursting open and diminishing the sustaining power of the compressed air to a point where the roof of the tunnel would be likely to fall in. The process of locking men through from the shaft to the tunnel, and *vice versa*, occupied from five to ten minutes. The air pressure used in the tunnel work was about 20 pounds to the square inch. From this air-lock the digging was pushed outward and downward gradually, until the necessary depth was reached for the floor of the tunnel. This opening was temporarily roofed with boiler iron, braced with wooden joists, and is marked in the engraving, "temporary entrance to the tunnel." The compressed air forced through the air-lock and the temporary shaft to the tunnel, as we have above re-



HUDSON RIVER RAILROAD TUNNEL BETWEEN NEW YORK AND JERSEY CITY.

marked, gave the workmen trouble by escaping through the silt and the cinders above, marked "loose filling." This was partially remedied for a time by a canvas wrapping, but finally it was necessary to stop work on the tunnel and improve the condition of the chamber. The workmen were engaged in digging away the silt beneath the temporary entrance and putting up the iron plates for the sides of the chamber, when the roof caved in upon them.

The tunnel—or more properly tunnels, for there are to be two, one for out-going and the other for in-coming trains—is a cylinder nearly round, about 22 feet high and 20 broad, made of boiler iron, filled in with brick. The men at the heading first dug a semi-circular opening at the top sufficient to allow the top plates to be placed in position, when they were bolted and braced before the earth beneath was taken out. The plates are 2 feet 6 inches wide, and alternately 3 and 6 feet

long, with 2½-inch flanges on each side, through which each is bolted to its fellow. After the lower earth was removed, the other plates forming the shell were put in position, and the bricklayers followed closely, laying a lining of hard-burned brick 2 feet thick, which presented an arch to resist vertical or lateral pressure. The lining fits closely to the iron plates, the 2½-inch flanges of which aid in retaining it. The work was illuminated at each end of the tunnel by electric lights from an electric generator which stood above ground, near the steam pumps, as seen in the engraving. The silt removed in the progress of the work—a mixture of blue clay and sand—was mixed with water and forced out of the tunnel by air pressure through a 6-inch pipe into the receptacle marked "Waste silt" at the bottom of the working shaft, whence it was raised in buckets to the surface, carted away, and mostly used for filling in the adjacent lowlands. An engine was used especially to run the air compressor, in connection with an air reservoir, 5 by 11 feet, sending a constant supply of fresh air through the ventilating pipe of the tunnel. The engine and other machinery above ground are shown in the engraving at the upper right-hand corner. They are enclosed in cheap wooden sheds. Three sets of workmen, composed of from 30 to 40 men in each shift, kept the work going night and day, each set working eight hours. They were able to make from 3 to 5 feet a day. Communication by telephone was preserved from the office above ground to the heading at the extreme end of the tunnel. When the work was interrupted by the accident, the digging had progressed about 300 feet in the northern and 20 feet in the southern tunnel.

Work on the tunnel proper was stopped some weeks ago, in order to improve the entrance from the air-lock to the tunnel. The top of the tunnel, as far as completed, is about 25 feet below the bed of the river. The river is 5,500 feet wide at the point where the tunnel is to cross, and it deepens till within about 1,000 feet from the New York side to a depth of 60 feet. The grade of the tunnel is to descend in accordance with this drop in the bottom of the river, and ascend the New York side more abruptly. The extreme length of the tunnel is to be about 2½ miles from Jersey City avenue, in Jersey City, where the trains are to leave the surface, to a point near Broadway and Bleecker street, New York, where they are to emerge. It is expected that about 400 trains a day can be passed through when it is completed, and that the different lines centering at Jersey City will use it in common.

From this description, with which many of our readers are already familiar from the very full accounts given in the daily papers, the plan on which the Hudson River tunnel is being constructed is seen to be very different from that usually employed in similar work, in that it dispenses with the use of caissons and shields, the only reliance against collapse and the influx of the superincumbent earth and water being the use of compressed air introduced into the workings, and which is expected to hold the soil at the headings in place, and, by driving back its moisture, to compact it so that it can readily be removed. This plan originated with Col. D. C. Haskin, the President of the Tunnel Company; and on its first announcement some five years ago, and on several subsequent occasions, was severely criticised in the columns of the Manufacturer and Builder, as radically faulty in principle, and liable to be specially hazardous in practice from just such accidents as that which has now occurred. The opinions then expressed have been fully justified by the event, as our readers will see further on.

Col. Haskin's plan of tunneling was first referred to in the January number of this journal for 1875, in an article entitled "An Alleged Improvement in Making Subaqueous Tunnels," from which we reproduce the following extracts, that our readers may observe how exactly the difficulties and dangers to be encountered were foretold:

"Mr. Haskin, in constructing submarine tunnels, . . . employs compressed air, which keeps the water back and also partially resists a collapse of the soft solid material. After his plan, the workmen labor in a kind of chamber containing compressed air, but instead of working at the bottom downward in a caisson open below, they work at one side, and thus forward, the compressed air being expected to resist the inward pressure until the masonry following the digging is completed. Behind them are air-locks to allow the men to enter and leave the chamber with compressed air. A great mistake in the plan, is that the inventor discards the caissons and shields proper; he expects that the air pressure alone will prevent any loose boulders, stones or quicksand from coming down on the workmen, as if the law of gravitation would not prevail in compressed air. He expects to use 50 pounds pressure, and we agree that this is sufficient to keep back a column of water 100 feet high; so that with this pressure he might descend 100 feet below the surface of the water, provided the air finds no escape by other channels than where the water comes in, and also that the water enters only in very narrow channels. If the water finds a hole to enter, say as large as an inch, the air pressure cannot keep it back, but will pass beside the water upward through the same channel by which the water descends, acting like the siphon of wine testers, which cannot hold the liquid back when the lower opening is not very narrow, this compressed air acting against the common air precisely as common air pressure acts against rarefied air.

"As an illustration of the patentee's want of hydrostatic experience and judgment, we copy one of his statements: 'If a jet, seam or small stream of water is encountered, I supply a temporary shield of canvas, leather or other flexible integument to the wall, against which the pressure instantly forces it and seals the leak.' He forgets that the same high pressure will prevail between the particles constituting the walls of the tunnel, and the application of a piece of leather will not change this pressure into a vacuum—his leather will not stick."

A similar unfavorable reference was made in this journal in May, 1875, to the Haskin project, and also in May, 1879. From the latter, in an article entitled "The Hudson River Tunnel," we make the following extract:

"This tendency of the air to escape upward is so strong, that in the Brooklyn caisson the air kept oozing out through the spaces between the masonry on the top of it, as if it were a sieve; and for this reason the caisson on the New York side was lined interiorly, sides and top, with sheet-iron, so as to make it air-tight. If in this case it was found necessary to line the sides of a caisson to render them air-tight, how will it be possible to prevent compressed air from finding its way out forward and upward through the soil in a horizontal tunnel? We positively assure those interested, that if they think it possible to work the 'caisson principle' in a horizontal direction, they delude themselves, as it is only adapted to be worked downward."

From these extracts, our readers will see that the position taken by the Manufacturer and Builder, from the first inception of Col. Haskin's plan to the present, has been shown to be strictly correct, and that the accident that cost twenty human lives, so from being unaccountable, was the logical result of an attempt to apply in practice a theory of engineering the radical faults of which had been clearly pointed out in advance in this journal.

The plan of driving a tunnel laterally through yielding materials, with nothing but compressed air to prevent it from collapsing, is an innovation on previous engineering practice, which can only succeed under exceptionally favorable circumstances. It has the obvious advantage of simplicity and economy, but the safety of the men employed in the work must first be considered, and the disastrous collapse at the Hudson River tunnel proves that the character of the soil to be encountered on the tunnel line is not adapted to the safe working of Col. Haskin's plan.

There is only one condition where Col. Haskin's plan can be safely worked, and that is where the soil encountered in driving a subaqueous tunnel is naturally stiff and solid enough to be self-supporting; and in such a case it would be unnecessary to employ compressed air at all, except on the principle of making assurance doubly sure. But in other cases, we reiterate the assertion that it is too uncertain and hazardous to be attempted, without needlessly and recklessly imperiling human life; and, furthermore, from what has been published since the accident, it appears that considerable loose, sandy ground will be encountered on the tunnel line, in which case *a repetition of the late disaster*, with even greater fatality, is not only possible, but highly probable. In view of all the facts, therefore, we submit that it is a question whether the authorities ought not to interfere to prevent the prosecution of the work on this tunnel in the manner in which it has been begun.

We know that men who go down into mines and tunnels, even where they are surrounded with every safeguard that intelligent supervision can devise, are, from the nature of their occupation, subjected to serious risks to life and limb. That such is the case, is unfortunately shown in the history of coal mining, and of nearly every great tunnel enterprise; in the cases, for example, of the Thames, Hoosac and St. Gothard tunnels, in the completion of which hundreds of lives were sacrificed. It may be argued that men who undertake work of this kind, are fully aware of its extra hazardous nature, and having done so, that they must be prepared to take the inevitable risks to life and limb that are necessarily connected with it, just as the soldier takes his chances in battle; that the sacrifice of a few human lives, which appears to be unavoidable, should not be permitted to interfere with the construction of works of great public convenience and utility, etc. But while this is admitted, it is equally true that the conductors of such undertakings are bound by every principle of humanity to take every proper precaution to lessen this hazard, and to use all means in their power to secure the safety of the men employed. They are certainly not justified in needlessly imperiling human life in testing a novel theory in engineering which has been repeatedly denounced as faulty, long before it was tested in practice, and which the accident of a few days ago proves to be unusually hazardous. On these grounds, therefore, we are of opinion that it is the duty of the authorities to interpose, with the view of determining whether this particular piece of work should be allowed to be continued as it has been begun.

The Decomposition Theory of Steam Boiler Explosions.

The "electrical" and "decomposition" theories of steam boiler explosions have always held a high place in the esteem of a certain class of mechanics who love the mysterious, and find in these highly improbable causes a convenient mantle with which to cover a multitude of sins of omission and commission.

We have always held that both of these theories were so highly improbable, that they might safely be left out of consideration in seeking for the causes of an accident of this nature. It appears, nevertheless, that there are certain circumstances under which water within a steam boiler may suffer decomposition into its elements—hydrogen and oxygen. But it is well to remember that if the *entire body of steam* existing in a boiler could be thus decomposed, it would only increase the existing boiler pressure by one-third; and the possibility of such an occurrence is too remote to make it worth serious consideration in the investigation of boiler explosions.

At a recent meeting of the American Academy of Sciences, an experiment was shown which proved, as we have just remarked, that under certain exceptional circumstances a partial decomposition of steam could take place. The experiment is thus described: The apparatus employed was a flask in which water was heated, a luter conveying the generated steam into a closed platinum crucible, where it was again heated by a spirit lamp, a tube then conveying the superheated steam and the liberated gases to an ordinary pneumatic trough, where the mixed gases were collected in a test tube, while the steam, of course, was condensed. At the conclusion of the experiment, the gases thus collected were exploded by a lighted match, showing beyond question that they were the component elements of water—hydrogen and oxygen.

The experiment in question was held to show that such an explosive mixture of gases may be formed within a steam boiler, but only by the most culpable carelessness. The boiler must, at least in part, be raised to a full red heat; then cold water must be injected, for so long as steam and gases are mixed, the latter cannot explode, and the injection of water must condense the steam in the boiler *before it cools the red*

hot iron. All these coincidences must be fulfilled before such a thing as an explosion of the gases can take place.

The Manufacturer and Builder.

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Extra Edition of October Number to General Manufacturers.

The special numbers of the MANUFACTURER AND BUILDER issued during the past two years, have met with such genuine appreciation from the particular lines of manufactures to which they were devoted, and from advertisers, that we have decided to publish an extra edition of 10,000 copies of our October number, for distribution among the principal manufacturing establishments throughout the country, not confining our list to any special line, as heretofore, but including all branches of manufactures. We call special attention to this extra number, and trust that we may receive the same liberal patronage that we have been favored with in the past. Applications for space should be made at once by those wishing to secure desirable locations. Rates for advertising will be the same as for our ordinary editions, notwithstanding the great special inducement offered.

The Drainage Question at our Seaside Resorts.

We do not anticipate that serious attempts at the purification and utilization of sewage can ever be successfully made on a large scale for the treatment of the drainage of great cities; and so far as we can learn of the introduction of such systems as practiced in Europe, their operations are conducted on a comparatively limited scale. For the present, we may be thankful if we can effectually rid ourselves of our offal; and while we may regret the fact that we are annually pouring millions of dollars worth of rich fertilizing elements into the convenient river that receives our drainage, for the present at least it cannot be helped.

We are, however, specially interested, in this article, with the manner in which the question of drainage is treated at our popular health resorts. Some of these places, especially the seaside resorts, which are visited during the summer season by hundreds of thousands of health and pleasure seekers, have absolutely no provision for the disposal of their sewage. The offal of these multitudes, year after year, is simply allowed to filter into the sand, or, where special provisions are made to receive it, they are of the crudest and most inefficient description. In the few cases where sewer pipes are employed, the solid refuse emptied into a convenient inlet or bay, is often swept upon the beach by the next tide. At other places these troubles are aggravated by the dumping of the garbage of adjacent cities so close to their confines, that the surf and beach are disgustingly defiled by it. Happily, the luxury of a bath with such floating accompaniments as decayed vegetables and fragments of what were once cats, and other things equally unsightly and unsavory, can only be offered by a few of the seaside resorts in the neighborhood of this city. But, annoying and disgusting as this is, it is an open question, in the presence of the serious dangers from defective drainage, or none at all, whether it really adds to the unwholesomeness of a soil already saturated with filth about the huge hotels and caravansaries. To come to the point, the foul condition of very many of these places has become so notorious, that many who were formerly their patrons, now avoid them—physicians send their patients elsewhere, and unless measures are speedily taken to improve their sanitary condition in respect to drainage, it is only a question of time when they will become disease-breeding rather than health-giving resorts.

Of this state of things it is pleasant to be able to note some exceptions; and at one of the best-known seaside resorts in the neighborhood of New York (Brighton Beach), the managers have had the rare good sense to introduce an admirable system of disposing of their sewage, which we should be pleased to see very generally introduced. The plan, as described in the newspapers of the day, consists in substance in receiving all the sewage into reservoirs, in which the solids are separated from the liquid portion by simple mechanical means. The liquid portion is then purified by chemical treatment, by which its organic matter is precipitated, and the purified liquid allowed to flow away into a neighboring creek. The solid matter is likewise subjected to a simple chemical treatment, and thereby converted into a valuable fertilizer. We mention this one circumstance, to show what can be done to remedy the crying evils of defective drainage at most of our seaside resorts, if only the effort to do so is intelligently made. The only questions are, whether the authorities of these places will take the initiative and do it of their own accord, or whether they will wait until an outbreak of infectious disease forces them to do it.

150 Miles an Hour. (?)

The question of high railroad speeds, on which we made some brief comments in our last issue, *apropos* of the building of special locomotives for rapid transit between New York and Philadelphia, has been attracting considerable attention at the meetings of some of our engineering societies.

We notice specially an interesting discussion of this topic which took place at the last meeting of the Franklin Institute, on the conclusion of the reading of a paper giving the details of the new Baldwin engine built for the Reading Railroad. In the course of this discussion, Prof. William D. Marks, of the University of Pennsylvania, stated that he had made some calculations of the maximum speed at which locomotive engines could be driven before the centrifugal force on the tires of the driving-wheels became so great as to cause them to burst. These calculations, which, however, were only approximate, indicated that the limit of speed was in the neighborhood of 150 miles an hour. A speed of 78 miles an hour has already been attained in several very exceptional instances, so that more than the half of the possible maximum fixed as the limit by Prof. Marks has been reached.

With any close approach, however, to such a tremendous speed as that named by this gentleman, other dangers than that of centrifugal force on the tires of the drivers will be encountered; and while it is not impossible that they may be overcome or provided against, it may be regarded, in the light of our present mechanical attainments, as highly questionable whether a speed of 100 miles an hour could be maintained for any distance without seriously imperiling some portion of the working mechanism of the engine or the safety of the train. The limits of safe practical working, making due allowance for probable advances in engine building, will most likely be found to be on this rather than on the other side of 100 miles per hour. This opinion is predicated, of course, on our present system of railway locomotion.

It is hazardous to venture predictions of this sort. Prof. Marks was obviously fully mindful of this fact, for when asked whether there was not danger that the heating effects of such rapid travel as 150 miles per hour would not be so great as to destroy the axles and bearings, ingeniously evaded the question. He replied that Dr. Lardner had published what he considered were demonstrations that the heating effects of revolving paddle-wheels of steamships would be so great as to burn them up before they could get out of their docks; and in view of the practical refutation given to these "demonstrations," Prof. Marks did not think it worth while to venture similar prophesies respecting the heating effects of high rates of speed on railways.

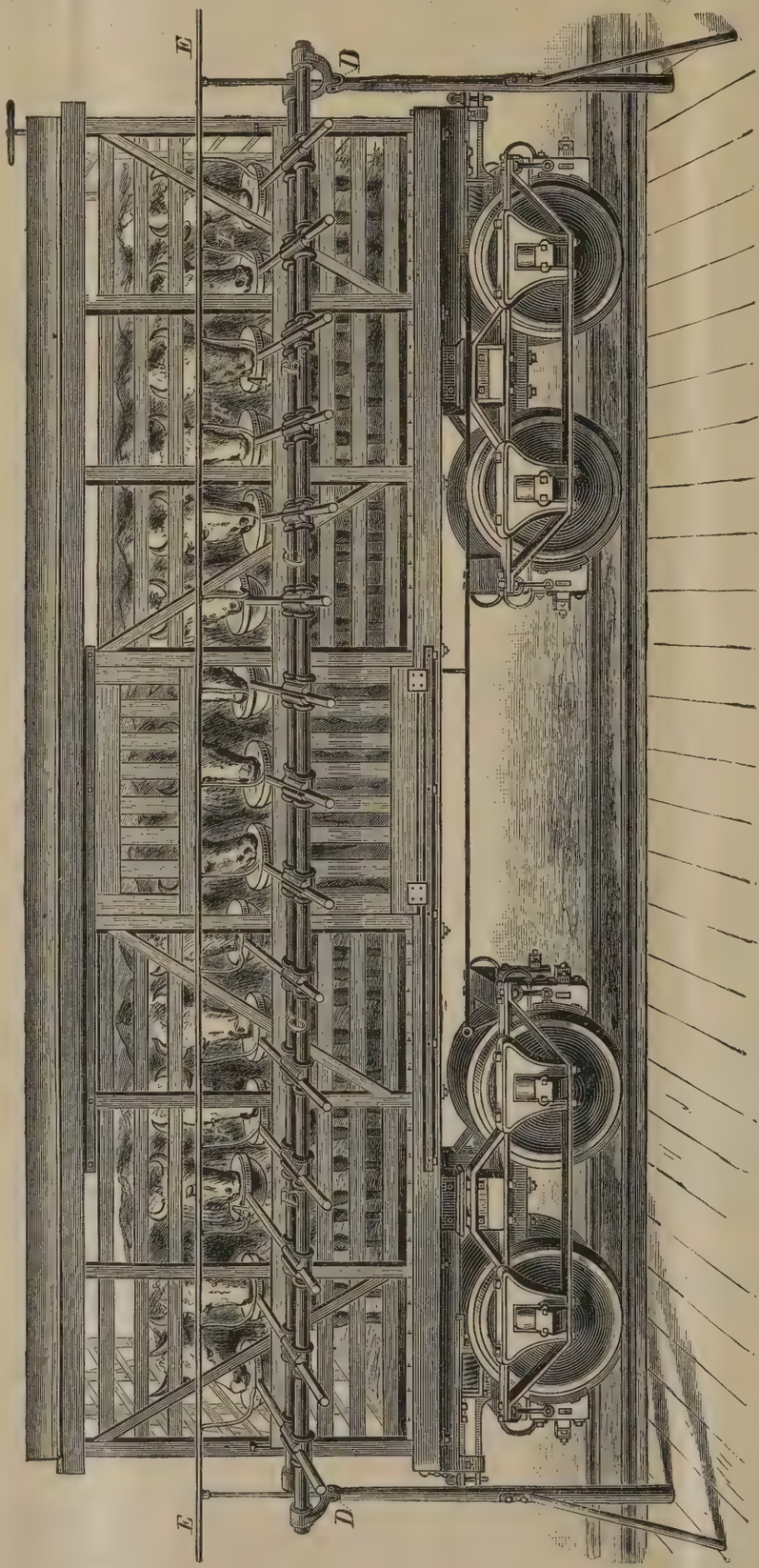
Nevertheless, while we appreciate the careful conservatism that induced so non-committal a reply to a very pointed and practical inquiry, we think that no competent mechanical engineer will be found who would not, if obliged to answer this question directly, respond that, with our present system of locomotion, the limit of the highest speed compatible with safety and economy that will be attained and maintained, will not be very far from that which has been indicated in a general way in this article.

Tingley's Improved Device for Feeding and Watering Live Stock in Transit without Unloading.

The raising and shipping of live stock has grown to enormous proportions in this country, and affords handsome revenues to all parties interested in the business—producers, middle-men, and the transportation companies being chiefly benefitted by its growth. The subject of the proper transportation of live animals over long distances, and giving them proper and merciful care and attention on the route, is one which interests a much wider class—the consumers, for, at present, leaving out of sight humanitarian considerations, which impose upon all the duty of avoiding and preventing the infliction of needless suffering and cruelty to animals, the condition of the flesh of animals brought to the shambles, after a journey of many days, during which they have, by reason of indifference or neglect, suffered untold agonies from hunger and thirst and brutal treatment, is often such as to make it utterly unfit for human food. The cruel and barbarous treatment to which animals in transit from the West to Eastern markets are frequently subjected, is an old and long-standing complaint. It has been publicly ventilated and denounced for years as shameful and inhuman, but up to the present time there has been no substantial improvement in the means and methods provided over those of ten or twenty years ago, when the business was in its infancy. There is, therefore, an urgent need for the introduction of plans by which the needless sufferings of these dumb creatures in transit may be lessened. But in any attempt of this kind, the humanitarian side of the question is not the only one to be considered, and any one who, on entering this field, ignores the vested business interests involved, will have his labor for his pains. This probably explains why, in spite of the torrents of denunciation that have been heaped on the transportation companies and shippers, no substantial reform has yet been accomplished. With the consideration of dollars and cents on one side, and that of sentiment on the other, the result may be safely predicted every time.

It has been fully demonstrated by actual practical tests, that by feeding and watering live stock regularly every 12 hours between St. Louis and Chicago and New York, 50 pounds and upwards in shrinkage was saved to each head of cattle, to say nothing of the improved condition of the meat. Hence the point of benefit and profit to the shipper is settled beyond all question. The following is an estimate of saving and profit to the shipper with 8 feeding and watering stations between St. Louis and New York: Allowing 16 head to each car, and a saving in shrinkage of 50 pounds to each head, or 800 pounds for each car, worth at least 8 cents per pound, makes a total saving on each car-load to the shipper, of $64. Estimated cost of feeding and watering, at the rate of 25 cents per head at each station, 16 at 25 cts.=$4; 8 stations at $4 per station=$32. Net saving to shipper per car-load, $32.

Whatever reform is attempted in this direction, therefore, must proceed from a rational consideration of the business interests involved, or it will be unsuccessful. The plans or methods suggested must be such as to demonstrate that they do not entail serious expenses without corresponding benefits in dollars and cents to those who must foot the bills. Of all the plans that have heretofore been suggested, none have been adopted by the transportation companies, for the reason that the entire burden of the expense was thrown upon them, without equivalent advantage. It has been suggested, for example, that the railway companies should build cars of special and expensive construction for this purpose, requiring the outlay of many thousands of dollars. It will be apparent that the companies cannot, or will not, carry out such plans without getting paid for their investment. This means increased charges, which fall on the shipper, who, seeing only an increased outlay, naturally opposes them. So the question has practically rested up to the present.



DEVICE FOR FEEDING AND WATERING LIVE STOCK ON CATTLE CARS.

In what has just preceded, we have looked at the subject from a strictly financial standpoint. To the great public, the most important consideration involved in it, is the condition and quality of the meat furnished to millions of consumers. This is a matter in which the dwellers in Eastern cities are vitally interested, for it is they who are called upon to pay the heavy penalty, in the form of sickness and disease, caused by using meat unfit for human food, by reason of cruel and inhuman treatment of the living animals during transportation. On this point, a few references will be instructive, viz.: The Cattle Commission of New York, in their report, say: "It became apparent to the Metropolitan Board of Health in New York city, that the alarming increase of obstinate and fatal diarrhœa in the metropolitan district, was caused by the use of diseased meat." And they add, "Not only do Western cattle lose a hundred pounds or more per head in transportation, but the tissues of their entire system are turned into a feeble, disordered and feverish condition." Prof. Agassiz says: "Let me call your attention to the dangers arising from ill treatment of beef-cattle before slaughtering them." Medical Inspector Hamlin says: "The flesh of mammalia undergoes great change by reason of fasting, disturbance of sleep, and long-continued suffering, resulting in its not only becoming worthless, but deleterious."

From 10,000,000 to 15,000,000 head of cattle, sheep and swine are brought annually from the West to supply our cities and larger towns with meat, and of which a large portion is exported to London and other large cities of Europe. It is estimated that 6 per cent of cattle and about 9 per cent of sheep and swine (nearly 600,000 in all), annually die while in transit, and much of the flesh and fat of these animals is sold in our markets, either as meat or rendered into cooking lard; while of the cattle that get through alive, many, by reason of want of food and water and cruelties inflicted upon them while in transportation, and after losing on an average nearly a hundred pounds in weight, come out of the cars full of fever, or with bruises, sores and ulcers; and these, together with smaller animals, to which the loss and suffering are in proportion equally great, are

all sold in our markets for food. Prof. Gamgee states in the *Edinburgh Veterinary Review*, that he has "known diseased cattle slaughtered, the beef of which had the appearance of being the best beef that a butcher can show, and yet pigs, dogs and ferrets died from eating it; and horses died from drinking the water into which the blood of one of these animals had run."

From these facts, it appears that cruelty to animals in transportation avenges itself upon the consumer, and that we shall never be secure against disease from eating poisonous meats until animals are properly fed and watered in transit, which can readily be done without materially adding to the expenses of transportation and with greater profit to all concerned.

One plan of doing this, and which appears to meet the requirements of the case very simply, inexpensively and effectually, is shown in the engraving on the opposite page. It represents a plan devised by Mr. A. D. Tingley, of this city, and is worthy the attention of all who are interested in this subject. It is a simple watering and feeding device, entirely separate from the cars, which is erected at suitable stopping places along the track, on both sides of the cars. Its construction and use will appear from the following description, reference being had to letters on the engraving: A represents a series of feed-boxes, with handles which slide back and forth on sockets B, and allow the feed-boxes to be pushed in and out the car as desired. The sockets or supports B of the feed-boxes, through which they slide back and forth, slide sideways on rod C of the framework, giving a lateral motion to the feed-boxes, to avoid posts and braces, when they are pushed into the car; D is a joint or hinge in the upright posts, which gives a slight rocking motion to the horizontal part of the framework, allowing the feed-boxes to be slightly raised or lowered; E is a main water pipe, and F represents small leaders from the main water pipe, to each separate feed-box.

It is designed to build a row of these on both sides of the track, and thus get at the head of stock, let it be where it may. The only alteration required to be made in the stock cars now in use, is to loosen one board on each side of the car at the nose of the cattle, and support it on hinges and hooks, so that it may, by lowering, provide an opening for the feed-boxes. This arrangement not only provides in a simple and inexpensive manner for the comfort of the cattle, but permits of their transportation with greater dispatch, since it obviates the labor and delay of unloading. The operation is as follows: The cattle train is run in between the two rows of feed-boxes, filled and in readiness. An attendant walking along the side, pushes in one of the boxes at each head, and after they have had sufficient time to eat, he turns on the water in the main pipe, and it is distributed to each feed-box by the pipes F. When the stock is watered, the feed-boxes are withdrawn, and the train may go on. For swine and sheep, an arrangement similar to the above, but slightly modified to suit its purpose, is provided.

From the above description, our readers will perceive that Mr. Tingley's device affords a very simple and effective method of providing live stock in transit with an abundance of food and water without the delay and labor of unloading. We esteem the device to be worthy the attention of all who are interested in the stock shipping business. Further particulars can be obtained by addressing A. D. Tingley, Manager, Union Live Stock Feeding Co., 115 Broadway, New York.

Avoidance of Vibration with Machinery.—Mr. W. H. Delano, in a paper read before the British Institution of Civil Engineers, spoke of the use of asphalt for the foundations of machinery, notably for those running at high speeds, the asphalt having the valuable quality of absorbing vibration. This was instanced in the case of a Carr disintegrator, which, being mounted in a pit lined with bituminous concrete, was worked at 500 revolutions per minute without sensible tremor, whereas with the former wooden mountings on an ordinary concrete base, the vibration was excessive, and extended over a radius of 25 yards. At the Paris Exhibition of 1878, there was shown a block of bituminous concrete, weighing 46 tons, forming the foundation of a Carr disintegrator, used as a flour mill, and making 1,400 revolutions a minute, a speed which would have been impracticable on an ordinary foundation. Extensive applications of the material for this purpose are made in France, especially in connection with steam engines and steam hammers.

Files and File Manufacture.

GENERAL REMARKS.

In concluding our series of articles on files and file using, it might be well to venture on a short recapitulation of some of the principles laid down in the first three articles. As regards shapes, the tang should in every case have curved shoulders instead of square ones. Round files should have a slender taper with curved shoulder, and not simply drawn to a point from the full round section. Band and hand saw files should have their corners blunted, but well cut; machinists' three-square files, not used for hand-saws, should have sharp corners. The double-ended file, with its appropriate special handle, presents many advantages as a saw file. Rifflers are better single-ended, and provided with a wooden handle, than when made double-ended with a metal grasp in the center. The file-card should be a well manufactured device, not an extemporized home-made affair, and is best combined with a scorer fitting in its handle.

Surface file-holders should be of such a character as to spring the file to any desired amount, while giving the workman full grasp. It is not generally remembered that the greater the convexity the fewer the number of teeth brought to bear on the work at once, and hence the greater the "bite" of the file without increased labor in pushing it.

In the cuts, Fig. 1 shows a surface file-holder devised by the Nicholson File Co., of Providence, R. I. It will be seen to grasp the tang and point, leaving the whole cutting surface free for work; and the screw handle puts any desired bending pressure on the file, so as to reach any required spot of the work, as well as to utilize every part of the file.

Fig. 1.

Fig. 2.

Fig. 3.

The vise file-holder of the same company (Figs. 2 and 3) is based on the same general straining principle, but the tang enters the handle. It is specially useful for lighter work at the vise.

Grinding and stripping should be done by machinery, as insuring greater evenness of surface than it is possible to attain by hand.

The teeth need not have sharp-angled indentations, which are liable to cause pinning, but may be sharp at the top and flat or blunt at the bottom of the indentation.

Machine file-cutting has been attempted since about the year 1700; but most machine-cutting has been imperfect in execution, or else planned so that it caused channeling and chattering in double-cut files, by reason of their extreme regularity of spacing. Furthermore, regularly spaced machine-cut files have, for this very reason, been harder to push on surface work than hand-cut, because, as the file comes on the work, proportionally more teeth bear on the metal than when the spacing and consequently the hight and the lateral angle of the teeth are irregular. The increment, irregularly spaced machine-made files present the most favorable combination of good features to the mechanic, and these we rehearse in detail.

The rows of cuts get progressively wider and wider apart from point to middle, and nearer and nearer from middle to heel. But this progressive increase and decrease is controllably irregular, and purposely so, just as a tap is given an odd number of flutes to prevent its cutting out of round. In addition to this, the successive rows are not exactly parallel, so that the shearing cut is smoother and more perfect, and the tendency to grooving and chattering entirely removed. The hight of the teeth has the same elements of intentional variety. The result of these advanced and tested principles is that the machine imitates exactly, or even with improvement, the good features of the intelligent and experienced hand file-cutter's work.

There is no department of the machine-shop where false economy and prejudice create so strong and insidious an influence for bad as in file purchasing, for the reason that there is scarcely any way, in a shop doing an ever changing variety of work, to measure the loss in time, and the lowering of quality and finish, that result from the purchase of wrongly made or badly made files.

Treatment of Yellow Fever in Africa.

A French physician—spoken of rather as heir to the once famous Duke of Gramont-Caderousse than in the capacity of a practitioner—Dr. Declat, has instituted by proxy at Senegal, some valuable experiments on the treatment of yellow fever, with apparently very satisfactory results. M. Declat had been led to infer, theoretically, from the symptoms of the disease, that phenic acid might be used in such cases with some probability of success as a prophylactic as well as a remedy. He accordingly forwarded a dozen bottles of the compound to a missionary, with practical instructions as to its use, and the request of a report on the facts. The missionary, an enlightened man with some knowledge of medicine and considerable experience of yellow fever, makes return that not only did he actually rescue from imminent death, by means of this remedy, several natives who were writhing under the pangs of the disease, but that he himself owes his life to its use.

Napoleon the First said that agriculture was the body and soul of the empire, and in the hight of his glory he gave the subject attention and encouragement, and established in France a department of agriculture. From the start given to this great art, the nursing mother of all the arts, France has become the richest and one of the most powerful and prosperous among the people of the earth; 39 out of every 40 of her population, according to statiscians, do not spend their income, but lay something by.

The Worthington Steam Pump.

The manufacture of Worthington pumping engines for water-works service has until recently occupied most of the attention and force of the patentee—Henry R. Worthington. These engines are now supplying 120 large cities and towns with water, the total contract pumping capacity per day being over 400,000,000 gallons, and the engines varying in size from 2,000,000 to 20,000,000 gallons in twenty-four hours. Lately, however, attention has been directed to increasing the trade in small pumps for ordinary service—mining, boiler-feeding, tank-pumping, oil-pipe lines, etc. The result has been that the force of workmen has had to be increased from 400 to over 650, and the works proportionately enlarged.

The valve motion is the important peculiarity of this steam pump. To effect it, two steam cylinders and two pumps are cast together to form one machine. The right-hand division moves the steam valve of the left-hand one, and *vice versa*. Under this arrangement one pump takes up the motion when the other is about to lay it down, thus keeping up a uniform delivery, without pulsation or noise. As the work is divided between two engines, the wear is also divided, and the lifetime of the machine doubled. The valves are plain slide valves, such as are used in locomotive and stationary engines. Added to its durability, the smooth and noiseless action of the Worthington steam pump makes it preferable on many important services, where the jar of a single-cylinder pump would be objectionable or destructive.

We illustrate on this page two patterns of Worthington pumps, differing only in the arrangement of the water end. Fig. 1 represents the machine as designed for general work, where the resistance does not exceed 150 to 175 pounds. The water-ways in this pattern are direct and the passages large, an important feature, especially for fire service.

We also give an illustration of the Worthington pressure pump (Fig. 2). This pattern is fitted with exterior packed, double-acting plungers, suitable for pumping gritty water or against heavy pressures. The packing around the plungers can be readily removed. These pumps are being extensively used in Western mines, and in the Bessemer steel works and oil-pipe lines throughout the country. In the oil line service, which is unusually difficult, several of these machines are each pumping through 100 miles of pipe 1,500 barrels of oil per day, against a pressure of 1,500 pounds to the square inch. This is the most severe pumping service that has yet been undertaken in this country.

The absolutely noiseless action of Worthington steam pumps so especially adapts them to the work of hydraulic elevators, that all such elevators in the country, with but few exceptions, are run by them.

The main office of the manufacturer of these pumps—Mr. H. R. Worthington—is at 239 Broadway, New York, with branch offices at 83 Water street, Boston, Mass., and 709 Market street, St. Louis, Mo. At these offices prices will be furnished on application, for pumping engines or steam pumps, for any service and of any size.

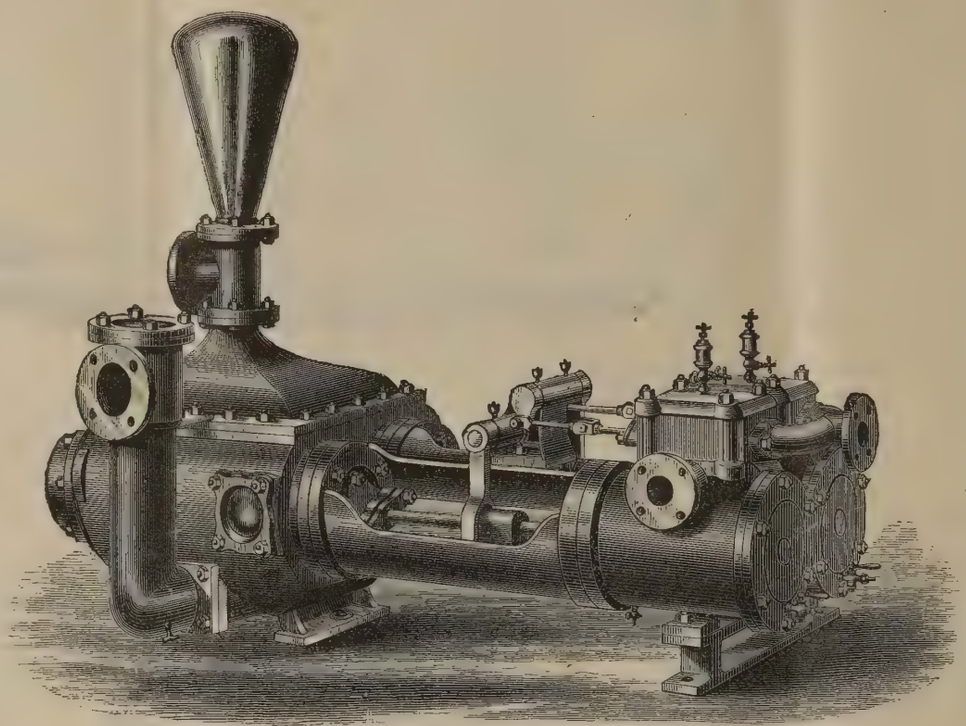


Fig. 1.—THE WORTHINGTON STEAM PUMP FOR GENERAL SERVICE.

TO DETERMINE THE NUMBER OF GAS BURNERS for a room of given size, there can be no very definite rule for lighting given. Much depends upon form of space to be lighted and color of surroundings, also on the quality of the gas. In ordinary dwellings with white walls and fair quality of gas, a five-foot burner will light brilliantly a space of 1,000 cubic feet. In public buildings, one half of the above amount of light will be sufficient, or one burner to 2,000 feet of space, although it would be well to provide for more light, in case the walls and ceiling should be of somber decoration. Much of course depends upon the arrangement of the burners; if uniformly distributed, a better general result is attained and fewer burners required.

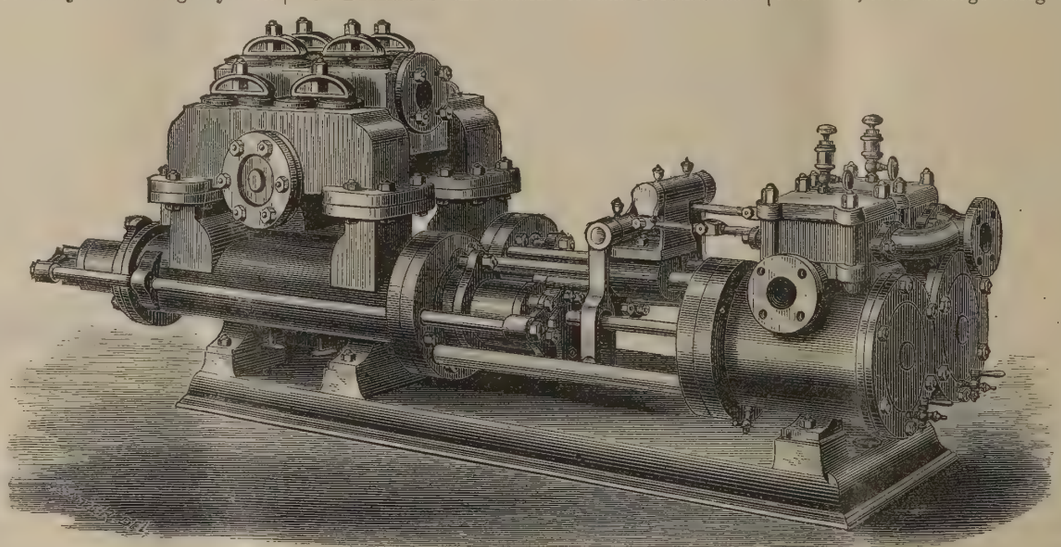


Fig. 2.—THE WORTHINGTON PRESSURE PUMP.

American Machine-Made Watches at the Sydney International Exhibition.

We are able to record with special satisfaction a complete and very remarkable success of the American system of watch-making at the late International Exhibition at Sydney, N. S. W. There were entered for competition, watches of well known Swiss, French, German, and English makers, and the United States was represented by but one exhibitor, namely, the American Watch Co., of Waltham, Mass. In all, there were ten competitors.

The judges in horology performed their duties very thoroughly. They agreed upon ten separate qualities for which they decided to examine the watches submitted, and fixed 100 as the maximum to indicate the highest degree of excellence in each of the ten qualities to be considered. From this it will be perceived that the highest possible score that any watch could receive would be 1,000. The result was no doubt very gratifying to the representatives of the American manufacturers, and is certainly one of the most decided triumphs ever gained by American manufacturers over foreign competitors.

The scores of the nine European exhibitors footed up totals ranging from 76 as a minimum to 686 as a maximum, their average being 389⅞ out of a possible 1,000. The score of the American Watch Co. footed up a total of 981. The following gives the score in detail: Originality, 98; invention and discovery, 95; utility and quality of material, 95; skill in workmanship, 93; fitness for purpose intended, 100; adaptation to public wants, 100; economy, 100; cost, 100; finish and elegance of cases, 100; time-keeping qualities, 100; total, 981.

The Astronomer-Royal who made the tests of time-keeping qualities, pays a very glowing tribute to the superiority of the American machine-made watch in this respect over all its competitors. He refers especially to the noteworthy fact that one of the sixth grade watches of this company gave a better performance than many of the most expensive hand-made watches. He says in his report, referring to a diagram on which he had plotted the change in rate of the watches he had tested at the observatory at Sydney: "Looking down the curves, it becomes at once evident that watch No. 5, which is

No. 670,068 second grade of the American Watch Co., is remarkably free from these defects, and presents the best rate of all the watches tested. No. 9, which is No. 2,526 Kullberg [a British exhibit.—*Ed.*], is the nearest approach to No. 5—indeed, the difference between its highest and lowest rate is 0.1 of a second less than No. 5; but it has not such a steady rate. The time-keeping of both these watches is remarkably good, and shows that we have entered upon a new era in the manufacture of pocket chronometers, for these rates are better than the majority of marine chronometers.

"Among the cheaper watches tested, No. 6, which is No. 1,221,336 of the American Watch Co., is worthy of notice; it is a watch of the sixth grade, yet its performance has been better than that of many very expensive and otherwise first-class watches among those tested. Such a watch speaks volumes in favor of the system under which it was made, and is the best comment upon the accuracy of the machines that produced it."

It is well that such triumphs of American skill as this one should be widely known to our own people, among whom there are still a few, who, in spite of their opportunities for judging by comparison, at the Centennial Exhibition, of the excellence of American manufactures, are still afflicted with the notion that a foreign brand or trade-mark is a vast improvement to the quality of purchased goods.

Shaw's System of Oil-Tank Construction.

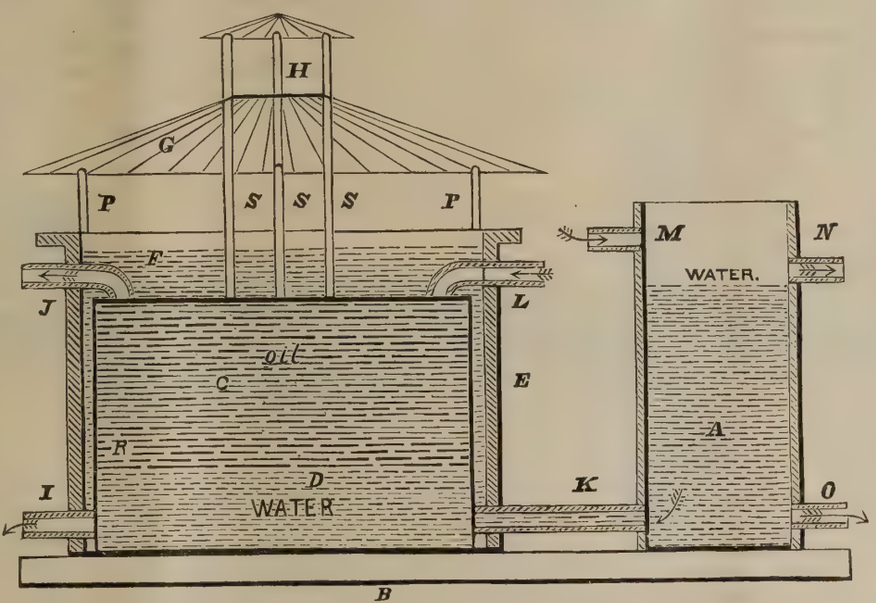
We describe in the following article, a system of oil-tank construction which appears to us to be so decided an improvement on the plans now in vogue, as to commend itself to the particular favor of oil companies and fire underwriters. We need not here enumerate or enter into a discussion of the merits of the many theories that have been elaborated to account for the special liability of such tanks to be destroyed by lightning; whether the tanks have or have not been properly rodded; whether they have or have not iron roofs, etc., since it is universally admitted that the direct cause of these disasters is the ignition of the oil vapor, or of explosive mixtures of oil vapor and air above and about the tank by the electric spark, which starts the ignition of its contents.

Starting with this general admission, we shall describe a system of tank construction devised by Mr. Thomas Shaw, of Philadelphia, the originator of many widely-known and ingenious inventions, which seems to strike at the very root of the difficulty, as it proceeds on the principle of constructing the storage tank in such a manner as to prevent, completely and perfectly, the generation and evolution of oil vapor in or about the same. If this can be accomplished, it will appear reasonable to affirm that the question of the manner of rodding the tanks at once sinks into a position of secondary importance, the prime element of danger—that is, the presence of oil vapor or of explosive mixtures of oil vapor and air above and about the tank—having been effectually guarded against.

We append herewith a description, with an illustration, giving the details of Mr. Shaw's invention. B represents the foundation which supports the tanks; R is the oil tank, closed top and bottom, and placed within a second reservoir E, open above, and designed to be filled with water above the top of tank R, to the level F. The water of the tank E, therefore, surrounds and covers the oil tank R. The oil is fed into the oil tank through the passage L, and drawn off through J, and the tank may be completely drained of its contents by the drain pipe I. A smaller water tank A, located beside the larger one, communicates with the oil tank by the passage-way K; M representing a feed-pipe for its water supply, N an overflow, and O a pipe for draining it of its contents.

It is scarcely necessary to note, that all the passage-ways shown and referred to are controlled by suitable stop-cocks. Above the large water tank E, and secured to it, is a metallic roof G, supported on short columns P P. This roof has an opening in its center, designed for ventilation, and roofed over at H. This roof is supported on rods S S S, firmly attached to the main roof G and secured to the top of tank R.

The operation of the system is as follows: The water tank A, so long as kept filled, insures a full supply of water to the oil tank, so long as the pipes I and O are kept closed. When oil is drawn off by the pipe J, its place is at once supplied by water from tank A, which will follow the oil upwards, as long as it continues to be drawn off at J, until, when the oil is entirely drawn off, the tank will be filled with water. When, however, the oil is allowed to enter the tank at L, it floats upon



SHAW'S SYSTEM OF OIL-TANK CONSTRUCTION.

and gradually forces the water down and back into reservoir A, through passage K. The surplus of water is discharged through the overflow pipe N, and when completed the tank R will be filled with oil.

The operations can be carried on simultaneously or alternated, as may be found most convenient; but, in either case, the tank R will always be completely filled with liquid, and there will be no opportunity for the generation and evolution of oil vapors, which is the prime element of fire danger in the ordinary storage system employed. To make assurance doubly sure, however, the outer water reservoir E is provided, by means of which the oil tank is kept completely surrounded and covered with a layer of water, which serves the double purpose of keeping down the temperature of the oil in the tank practically uniform at all seasons, and practically isolating it from the influence of surrounding atmospheric disturbances, of which lightning is the agent most seriously to be dreaded. To recapitulate, the peculiarities of the system here described reside in the employment of two bodies of water; one to submerge the oil tank, its purpose being to isolate the oil tank from external influences—heat and electricity—and the other to keep the surface of oil flush with the top of the tank, thus confining the oil in a closed and completely filled tank, leaving no air space above the oil surface to permit of the liberation of vapor and the formation of explosive mixtures of oil vapor and air.

Mr. Shaw has a very clear comprehension of the dangers to which oil tanks are subjected, as will appear from the following extract taken from his patent. In this he says: "Oil vapors, with the proper mixture of air, will ignite explosively at temperatures long before heat becomes visible; in fact, the feeble blue electric spark (invisible in daylight, and so low in temperature that it is received on the finger with no more sensation than that produced by a single thread of a spider's web), is competent to ignite the same at every emission of the spark. All masses of material, however feeble their conducting power, serve as a medium for electrical communication; and if any portion be partially insulated, electric sparks more or less powerful are induced, and if any ignitible vapor be in its path, combustion, and possible explosion, is certain. It is not necessary for a thunder-bolt to strike an oil-tank to ignite its contents. Any highly charged electrical cloud passing over the tank may induce a sufficient spark for the ignition of any combustible vapors, or a thunder-bolt may strike the ground miles distant, and the electric discharge be conveyed by means of the piping or other metallic substances leading to or from the tank. Large exposures of metallic surfaces offer sure protection from the violent force of a thunder-bolt, by reason of the extended metallic surface diffusing the electrical fluid; but there will be feeble sparks emitted in abundance, and one of them is competent to create a disaster by igniting oil vapors; and it is on this theory that the present invention is designed, the entire object being the prevention of generation and accumulation of combustible vapors or gases, and that object is effected by so arranging the oil tank as to keep it always full of liquid, in which case there is no space for vapors or gases to accumulate in."

Mr. Shaw's ideas, as embodied in his system of tank construction, are correct. We have certainly seen nothing up to the present time which can compare with his plan in the thoroughness of his safeguards, and if our knowledge of the causes of oil tank fires by lightning is worth anything, it teaches that the general principles which have guided him in the system of tank construction just described, will sooner or later come to be generally adopted, as embracing the first and essential conditions of safety.

Mr. Shaw may be addressed at No. 913 Ridge avenue, Philadelphia.

Glucose.

The manufacture of glucose in this country has grown to enormous proportions, there being at present no less than $30,000,000 invested in it. The material here is made entirely from corn, and so successful has it been, that quite a *furore* exists in connection with it throughout the West, where a number of new factories are being set up. This industry originated in the year 1863, with Messrs. Gessling & Bradley, who at that time improvised an experimental factory in Buffalo to determine if grape sugar and syrup could not be made from corn. The product had been made for years in Europe from potatoes, and imported into this country at prices ranging from 8 to 12 cents per lb.; but up to that time sugar from corn was not known as a commercial article. The experiment was successful, and from this beginning has gradually developed what is now an immense industry. At the present time, instead of importing from Europe an inferior article of grape sugar made from potatoes, at a cost of from 8 to 12 cents, as above noted, large quantities of corn sugar are exported at about 3 cents. A bushel of corn produces 30 pounds of glucose.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

Alterations are now being made in the Park Theater which will cost $20,000.

Smith and Howe have prepared plans for a factory for General Spinola, to be built on Eighteenth street, between Avenues A and B. It will be three stories high, and cost $20,000.

It is expected that a large mining exchange will shortly be built at a cost of $800,000, in the vicinity of the Drexel Building. It is reported that the land has already been purchased and architects' plans accepted.

The *World* Building, 37 Park Row, in which the office of the Manufacturer and Builder is situated, now five stories, is to be raised to seven stories, and to be provided with an elevator. The cost of the improvement will be $25,000. Owner, Orlando B. Potter.

The Second Baptist Church congregation, at Harlem, are building a new edifice, to cost about $50,000; it is to be of Philadelphia pressed brick, with stone finish, and is to seat over 800 persons. The style of architecture is Romanesque. The auditorium is to be 60x70 feet, and the tower at the southwest corner will be 120 feet high.

H. J. Schwarzmann & Co. have completed designs for the Germania Theatre. It will have a frontage of 80 feet on Third avenue and 150 on Fourteenth street. The main front will be of stone, and other parts of brick with stone finish; adjoining will be a concert hall, of iron, 84x103 feet. The total cost will be about $300,000.

Morris L. Herrman has nearly completed, at 18 White street, a dry-goods warehouse. It covers a full lot, fronting 25 feet on White street, by 96x100, is five stories high aside of the cellar, and built of Philadelphia Peerless brick and Bedford stone. The store front is of iron. The building is not supassed as to stability of construction by any other building in its vicinity.

The directors of Barnum's Museum Co. state that the Madison Square Garden will be taken down about Sept. 1, not August 1st, as stated in our July number. Anticipating this, the directors propose to call on about six of our leading architects to submit plans for the proposed new building, which will embrace the ideas promulgated in the company's circular. The managers say that the competition of architects will be conducted on business principles, and that all those who are invited to compete will be duly recompensed for their trouble and expense.

More money has been expended this year for new buildings and substantial repairs and improvements in New York City than at any time since 1873. The returns of the Department of Buildings for the six months ending July 1, show that 1,100 new buildings have been commenced, at a total estimated cost of $14,800,000, or nearly $13,500 for each. This is three million dollars more than was expended in the same period of last year, and double as much as in 1877. A great many apartment houses on the "French flat" plan are being erected, while the number of tenement houses is decreasing.

Some months ago George Bliss and F. H. Cossitt, the owners of the fine buildings just completed at the northeast corner of Broadway and Grand street, which replaced the structures recently burned, said, in speaking of the plans for the present buildings: "We intend to put up some buildings there which shall be as absolutely fire-proof as possible. They will not exist for show, although they will be ornaments to the neighborhood. They will be constructed in an especially substantial way, for the convenience of some of the large, well established mercantile firms of New York." These promises have been fulfilled. The buildings which have just been finished are six stories high with a basement, and are models in the way of business structures. The precautions which have been taken against fire are perhaps not excelled in the construction of any other buildings in the city. The walls are brick and the Broadway, Grand and Crosby street fronts are faced with iron. The iron is all backed with brick so as to make it impossible for fire to be conducted from one floor to the other through the walls, as the walls are solid. Even the iron posts are filled with brick, and the sash weights are hung outside. The cornice is metal backed with brick. The roof is tin and the ladders leading to the scuttles, as as well as the scuttles themselves, are of wrought iron. The boilers for supplying steam-heat and power are under Crosby street, outside the line of the building wall. Smoking in the building is prohibited, and lighted matches will not be allowed, as the gas is lighted by electricity. The Automatic Fire Alarm goes to every part of the buildings. The District Telegraph is connected with the buildings which will have the additional protection of the Night Patrol. Vertical pipes run outside the buildings, on Broadway and Crosby street, for the use of the City Fire Department. A tank holding three thousand gallons on the roof is connected with leaders on every floor where fire hose can be attached, and fire extinguishers are distributed about the buildings. The exterior of the buildings is a plain façade on all three streets painted white. It is very high, and impresses the spectator with its solidity. The basement ceiling is twelve feet high, and the ceilings of the first floor and lofts are a number of feet higher. There is an abundance of light making each floor an extremely attractive show room.

Miscellaneous.

A new passenger depot is to be built at Fergus Falls, Minn.

A window-glass factory is to be built at Monongahela City, Pa.

A court-house is to be built at Corsicana, Texas, to cost $40,000.

A hotel, capable of accommodating 300 guests, will be erected on Starin's Glen Island, Long Island Sound.

A Catholic protectory is to be built on Fair Haven Hights, near New Haven, Conn., to cost $100,000.

A freight depot is to be erected by the Chicago, St. Paul, Minneapolis & Omaha Railroad, at Minneapolis, Minn. It will be 330 feet long, 45 wide and one story high.

The Board of Education of Chicago, has authorized its building committee to order plans and specifications for two large school buildings.

An Odd Fellows' hall is being built at Gorham, N. H. The building is to be of wood, and will cost $10,000. The architect is Alden Frink, of Boston, Mass.

Nicollet county, Minn., is building a new $30,000 court house at St. Peter, and the basement, which is Kasota stone, is rapidly approaching completion.

Lilly, Brackett & Co., of Boston, are about to erect a shoe factory at Brockton, Mass. It is to be 207 feet long, 36 feet wide and 45 feet high; estimated cost, $18,000.

A passenger station for the Troy & Greenfield and Connecticut River Railroads is to be erected at Greenfield, Mass. It is to be a brick building, for which the State appropriation is $15,000; H. W. Hartwell, of Boston, is the architect.

The residence for Cornelius J. Vanderbilt, at Hartford, Conn., from plans by John C. Mead, is rapidly approaching completion, and will cost from $50,000 to $60,000. The terrace wall on the front and east side will cost $15,000.

S. J. F. Thayer, architect, of Boston, has completed plans for a new town hall to be built at Stoughton, Mass. It is to be a two-story brick building, with brick and stone finish, and will cost $32,000. J. W. Coburn & Co., of Boston, are the contractors.

Hamilton, Ont., is to build a city hospital on the pavilion style. The building is to be well ventilated and heated. Accommodations are to be provided for 96 patients, rooms for nurses, a household of 12, and four private wards. The building is to cost $20,000.

A passenger-station is about to be built by the Pennsylvania Railroad Company, at Merrick, Filbert and Fifteenth streets, Philadelphia. The station will be about 60 feet high, with a frontage of 170 feet on Merrick street and 118 feet on Filbert street. It is supposed that the elevated road will be finished and the station built by Jan. 1, 1881.

The Sisters of the Third Order of St. Francis are to build a hospital at the corner of Broad and Mifflin streets, Philadelphia, which will be called St. Agnes' Hospital. White freestone will be the material, and the hospital will consist of a main building with two wings, capable of accommodating 300 patients. It will be four stories high, counting the elevated basement. There will be a dwelling for the Sisters in the southwestern portion of the lot, fronting on McKean street; a chapel in the rear center, and the physician's dwellings on Mifflin street. The estimated cost of the whole is $100,000. E. F. Durang is the architect.

The first of the series of school buildings to be erected at Garden City, Long Island, by the estate of A. T. Stewart, is nearly completed, and will be ready for occupancy in part by the spring term, and the entire building will be ready by the following Fall. It will accommodate 500 students. The school buildings and annexes will be seven in number, and when equipped and endowed, will be transferred to the Protestant Episcopal Diocese of Long Island, upon the conditions and for the purposes devised by Mr. Stewart. They will be known as the Cathedral School of St. Paul.

The plans for a building to be erected by St. Luke's Hospital, St. Louis, have just been completed, and the architects will give out the contracts within a few days. It will front 100 feet on Washington avenue, with a depth of 30 feet on Twentieth street, measuring 80 feet from the sidewalk to the apex of the roof. It will be built of pressed brick, with facings of stone and black brick, with high windows, and have the general appearance of a solid and substantial structure. The outside walls will contain an air space, which will be conducive toward thoroughly ventilating the entire building. The structure will cost about $25,000, and will probably be finished by next spring.

The Industrial Exposition Association of Milwaukee, Wis., is to erect a handsome and commodious structure for its use, and has just accepted a plan for a building that will cover the Rink square and cost about $200,000. The main hall and annexes will afford room for twenty thousand people and the design contemplates a permanent museum, aquarium, art gallery, and greenhouse. The building will be in the Queen Anne style, and will be crowned with a dome a hundred feet in diameter, with a lookout one hundred and forty feet above the level. The portions of the structure in which the museum, aquarium and art gallery are to be will be fire-proof, and collections of the Wisconsin Natural History Society are to form a nucleus for the museum.

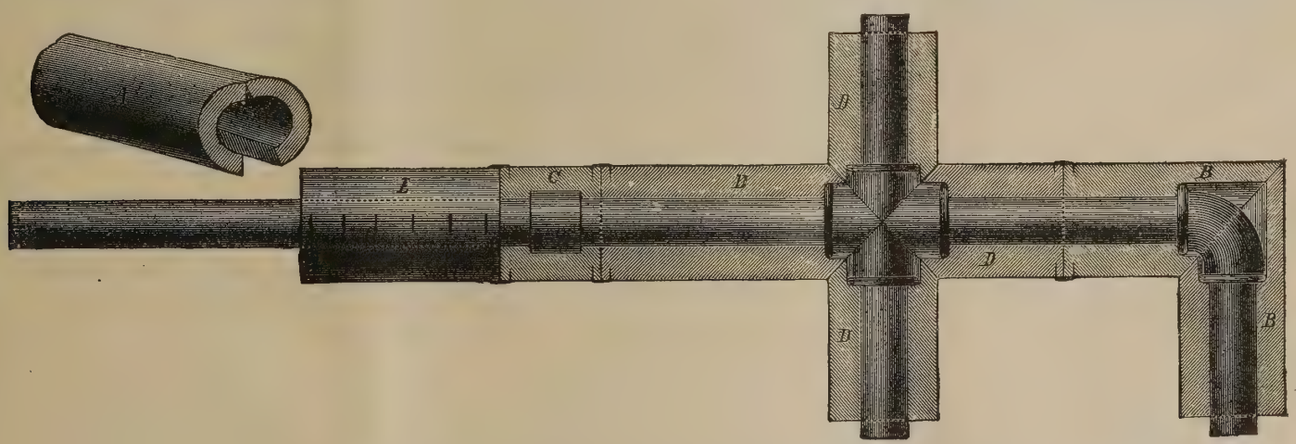
Plans have been prepared for a new building to be erected on the Girard College grounds, Philadelphia, west of the chapel. It will be of the college Gothic style of architecture, the exterior being faced with white marble, and the trimmings of Pennsylvania blue marble. The interior will be plain, but of a substantial character, the stairs to be of iron, and the corridors leading thereto of fire-proof construction. Steam is to be used for heating, and the ventilation is intended to be perfect in every detail. The building will be 300 feet in depth, running north and south, with a frontage of 80 feet in depth from the north end by 50 feet in depth. This portion will be three stories in hight, and will contain the sleeping apartments, dormitories, baths, and the office of the matron, with general storage rooms for supplies, etc. The dining hall will adjoin, and will be a building in itself, having accommodations for feeding 1,000 boys. It will be 95 feet in width by 120 feet in length, with serving-room and kitchen apartments, officers' dining-rooms, sculleries and dining-room for servants, covering an additional area of 66 by 140 feet. It will be a one-room apartment, lighted and ventilated by a central lantern, the kitchen attached being also one-story high, and the offices adjoining on either side being for servants' bed-rooms. Beneath the dining-hall, in the basement, will be a gymnasium.

Reed's Non-Conducting Covering for Steam Pipes, etc.

The material above named, which we have examined with some interest, is a species of compact felting made from woolen rags, being laid up by winding upon a mandrel. It is made in sections, 3 feet long, and from 1 to 60 inches diameter, to suit the size of pipe or boiler to which it is to be applied. The material possesses, beyond any doubt, excellent heat insulating qualities, and this, together with its elasticity, and the ease and convenience with which it may be applied to its intended uses, give it decided advantages over many of the materials in common use for the same purpose.

Cement coverings are objectionable for several reasons. They are troublesome to properly apply, and in most cases become so brittle after a short term of service, that the expansion and contraction and jarring to which they are subjected, frequently cause them to crack and fall off. Again, it is impossible to remove coverings put on in a plastic state, without destroying them.

These, and other objections of less moment, are entirely done away with in the covering here described. It is very light, so that with a thickness of ¾ of an inch, which is ample for ordinary cases, it weighs only one pound to the square foot of finished surface. It is a homogeneous, fibrous mass in composition, and is both tough and elastic, so that when once attached, cracking or falling off by jarring is impossible.



IMPROVED NON-CONDUCTING COVERING.

The mode of attachment commends itself especially by reason of its convenience. It is made in sections fitting the pipe to which it is applied, and may at any time be removed when alterations or repairs are necessary, by simply withdrawing the pins that hold it in place, and may be replaced again, or the line of pipe may be taken down and transported to a distance without danger of injury to the covering.

The manner of applying this covering is well shown by the accompanying engraving. As before remarked, this covering is made in sections 3 feet long, and from 1 to 60 inches diameter. Sizes up to and including 6 inches diameter are slit up one side, and the elasticity of the material permits it to spring open far enough to pass over the pipe. It then only requires to be fastened in place, which is effected by the use of sharp-pointed coppered staples provided for the purpose. Sizes larger than 6 inches diameter are cut in two or more pieces longitudinally, as may be found convenient. A, in the cut, shows a section sprung ready to pass over the pipe, and successive sections are laid on and driven up close. The fastenings, according to the recommendation of the makers, should not be made permanent until the covering has been on for 12 or 24 hours, with steam passing through the pipes, as the material shrinks slightly. When the covering has been in service for the time specified, the sections should be forced up close and the staples driven in about 3 inches apart along the seam or seams; C represents a section of the covering over a sleeve. In fitting the covering, the makers recommend that it be laid on to within several inches of the sleeve, then stopped, and commenced again about the same distance on the other side of the sleeve. The short section is afterward filled up by cutting a piece of proper length and removing enough of the felt from the inside to allow it to fit over the sleeve. These short sections, when the whole pipe line is covered, have the advantage of showing exactly where a sleeve occurs, so that in case of alterations or repairs it is only necessary to remove the short sections, and the longer ones may remain undisturbed. There is room enough on each side of the sleeve, when the sleeve section has been taken off, to apply the tongs and unscrew the pipe.

The simplest plan is, of course, to use no special sleeve sections, and simply cut out enough from the inside of one of the full sections to pass over the sleeve, when one is encountered. The other plan, however, though not the most speedy, has the special advantages that we have named above.

On reaching an elbow, the lengths are cut mitering all across the section, and enough is then cut out from the inside to enable them to pass the fitting. B in the cut shows this form of joint. D shows the appearance of a cross or double branch after covering. The sections are cut mitering, and enough removed from the inside to pass over the fitting. The method of covering other forms of joints will be understood from these examples.

Curved pipes can be covered in the following manner: Take a section of covering, cut enough saw-cuts across the length of the section to allow it to bend. The number of cuts depends entirely on the curve; if a short curve, the cuts are required to be closer than for a long one. The process is similar to the way a carpenter cuts a piece of wood to bend around a circle. The cutting is all done with an ordinary hand-saw. When the pipe is large, and the fittings are too heavy, and would necessitate the taking of too much of the covering away to allow it to pass over the fitting, a separate section is made, to pass over the regular section, which can then be cut as before described, to suit either kind of fitting. When exposed to the weather, it is necessary to give the covering several coats of paint, to protect it.

The makers claim the following advantages for their product: 1. Its entire freedom from liability to crack or crumble; 2, its freedom from liability to injury by fracture from blows or otherwise; 3, the cleanliness and convenience with which it may be applied or taken off and replaced, when necessary to do so; 4, its extreme lightness; 5, its excellent non-conducting qualities; 6, its indestructibility at any temperature at which steam is used.

These claims would seem to be fully justified; certainly it would be difficult to find a substance better adapted for the purpose of heat-insulation than the felting which they employ; and on the score of convenience, the form and manner in which it is applied, leave nothing to be desired.

This covering is manufactured by J. A. Locke, 32 Cortlandt street, this city, from whom further information may be had on application.

A Steam Catamaran.

Commodore William Voorhis, of Nyack, N. Y., has had recently constructed a steam catamaran, which is believed to be the first steam vessel of this description ever built; and the idea was wholly the owner's, he having worked on his plans for the past six years. The two hulls are cylindrical in shape, very much resembling two immense cigars. They are constructed of $^{3}/_{16}$-inch iron plates, are 200 feet in length and 5½ feet in diameter at their largest part, tapering to a sharp point fore and aft. They are 9 feet apart, connected together by means of white pine beams resting on white pine saddles. They are kneed by hackmatack knees, and braced by iron braces on the inside and outside, thus furnishing a deck 25 feet in width over all. All this is inclosed, making a commodious and pleasant cabin almost its entire length, with a small open-deck space outside fore and aft. The rudder posts—one to each hull—come up through sleeves 20 feet forward of the extreme after part of the hulls, and playing under them. The rudders themselves are 2 feet deep and 6 feet in length, constructed of thin iron. The rudder post is secured to them 2 feet abaft the forward end. They are geared together at the top, and both are worked by one wheel, the pilot-house being in the usual location, above the forward cabin. The steamer is to be propelled by a Wells balance engine of 476 horse-power, having a cylinder 24 inches long, 12 inches in diameter, with a stroke of 12 inches. The shaft is of steel, 4 inches in diameter, 8 feet long, and is placed on an incline, giving the boat an upward and forward movement. It is expected to make 325 revolutions a minute. The engine is supplied with steam by a Herreshoff coil boiler, 8½ feet long and 8½ feet high, containing 1,250 feet of coil. The propeller is six-bladed, 8 feet in diameter, and graduated from 7½ to 8½ feet pitch. The hub is out of water, as are also four of the six flanges. The whole boat is 42 tons burden, with a displacement of 72 tons, and only draws two feet of water.

Light and Heavy Blows.

The difference in effect between a blow delivered by a light hammer traveling fast, and one delivered by a heavier hammer traveling more slowly, is that the effects of the blow are more confined in the first case, and more spread in the second. The blow from a light hammer penetrates but slightly below the surface; while a blow from a heavy hammer penetrates deeply into the metal which is being forged. In practice, it will be observed that light, quick blows have a tendency to drive out of shape, split and break the iron; while the force of heavy blows, with a heavy hammer, moving slowly, penetrates deeply into the iron and forces the mass of the metal out into the desired shape.

Every wood-chopper knows the difference in effect between the effort to drive a wedge into a tight place by light blows or by heavy ones.

Explosion of a Locomotive Boiler.

From the record of the Hartford Steam Boiler Inspection and Insurance Co., we select for illustration this month the case of an explosion of a locomotive boiler, which presents some interesting and instructive features, inasmuch as the study of the cause of the explosion renders it probable that the very means that had been taken to strengthen the boiler became indirectly the cause of its weakening and subsequent explosion by a slight over-pressure. The ingenious analysis of the obscure points of this case shows good scientific reasoning.

We present its history, slightly condensed, as given in the Hartford company's monthly bulletin. The locomotive "Lehigh," which exploded in Hoboken, N. J., on the 28th of October, 1879, killing the engineer and fireman, was a passenger locomotive that had been remodeled in 1874, at which time the boiler was new. It had been in constant service, except while undergoing slight repairs, since May, 1874, on the Morris & Essex division of the D., L. & W. R. R. It was re-built under the direction of the master mechanic of the division, and was stayed in an extraordinary manner, having over fifty sling stays from the arch of the wagon top to the crown bars of the furnace, arranged in four rows, set as nearly radial to the arch as practicable (see Figs. 1 and 2). There were also horizontal cross stays from side to side of the shell between the crown bars, one to about every 5½ inches, and the crown bars were spaced the same distance apart, and consisted each of two broad parallel bars seated edgewise on the edge of the side plates of the furnaces and secured to the crown sheet by bolts, washers and gibs, in the usual manner (see Fig. 1). The shell of the boiler was made of $^{5}/_{16}$ iron plate, marked C. H. No. 1, and the pressure was limited to 130 pounds per square inch. There were two "pop" safety valves and a steam gauge; the latter was tested by the master mechanic after the explosion, and he swore that it was correct and its connection to the boiler free from obstructions. The iron was tested at the Stevens Institute, and found to have a good degree of tensile strength, namely, 46,000 pounds. The accompanying cuts are intended to illustrate the construction and the character of the defect from which the explosion arose. Only such parts of the boiler as were supposed to be concerned in the explosion are shown in the cuts. The only plate involved was the crown-plate of the wagon-top, which was about 6 × 7 feet in area, out of which a piece 5½ × 1½ was torn from the right side and blown away a considerable distance, the reaction overturning the engine upon its left side. The opening is bounded by the fastenings of the cross stays on the lower side, by the fastenings of the right-hand row of sling stays on the upper side, at the forward end by the waist seam of rivets, six of which were sheared off, and at the back end by the foot of a short head brace, shown in Fig. 2. Fig. 1 is a section back of the dome, and Fig. 2 is a side elevation of the wagon top and dome, all other parts omitted in the drawing (*not* torn off by the explosion).

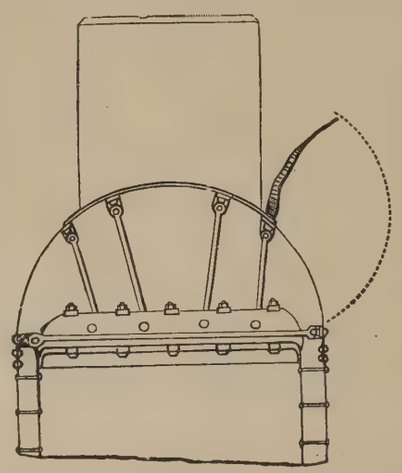


Fig. 1.

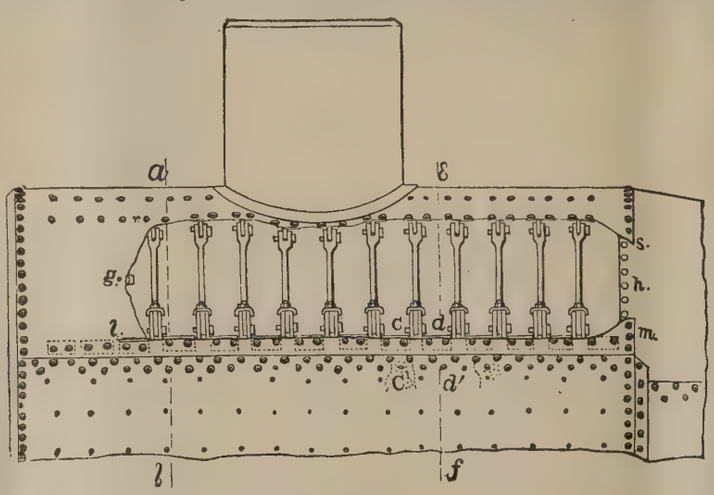


Fig. 2.

Fig. 3 is a full-size section of the plate and seam at *c d*, Fig. 2, where indications of a recent leak were observed, shown by dots, Fig. 2. At *c*, Fig. 3, is seen the character of the defects. Fig. 4 is cut from a sketch, full size, of the edge of the plate *c d*, shown in plan. The lines *v v* indicate the worn edges of the laminæ of the plate covered with old iron oxides and clayey sediment from the interior of the boiler. The inner boundary of the new fracture is indicated by its sparkling and bright appearance, and the dotted portion represents its area as compared with that of the old fracture. This appearance was observed to extend a considerable distance each way from the points *c d*, the proportion of old fracture varied, in general rather diminishing each way. It is probable that the fracture began at this point and extended forward and backward, reaching the waist girth-seam forward; when a sufficiently long line was forced from its proper connections with the adjacent part below, it was bulged outward by the force of the expanding water, and the strain thus produced sheared the rivets of the seam. The progress of the explosion is now plain and natural. The gushing of the entire contents of the boiler, now relieved of superincumbent pressure, out of this opening, strips the plate along its supported boundaries, and is blown away, while the machine is capsized by the reaction of the issuing stream. The pressure on this area of 7¼ square feet was but little less than 70 tons at the maximum pressure of 130 pounds per square inch, and something like this force would react on the machine to overturn it if the opening had been made instantaneously, which would have been quite sufficient not only to overturn the machine when applied to its side, but to lift it bodily in the air if it had been applied at its center of gravity and issued downward. The time that elapsed between the initial break and the entire separation of the piece of the plate that was blown away, allowed the internal pressure to fall somewhat, but the time was something like that which expires between the lighting of the cartridge and the rending of the rock; and notwithstanding the force was to some extent employed in breaking the plate, still enough remained, reacting on the atmosphere, to upset the engine. The balance of the force that was employed in overturning the locomotive must, therefore, have been tremendous in velocity to have done this work.

The problem as to the cause of the defect from which this explosion arose, is more difficult to solve. It is proper to ask what is the legitimate office of the extra stays that we find in this boiler; and since there are, according to the evidence adduced in this case, thousands of locomotives in which they are not found, we may well ask whether they are needed at all when crown bars in sufficient number and size are applied to support the top of the furnace. It may be difficult to understand just how the extra expansion of the furnace could, by thrusting the shell outward in all directions, cause the development of a crack on the inner surface of the plate; but knowing that expansion has a sufficiently forcible character, we may with tolerable fairness suspect that unequal expansion of the parts was the cause. The question naturally arises in this connection, Would the fibers of the inner surface which suffer compression when sharply bent along the line of a rigid support, when the side or horizontal thrust is outward and the radial thrust is upward, flattening the arc between, on returning to the form it had when cold, be more readily wasted or acted on chemically by the water in the boiler than those fibers of the outer surface which suffer distention during the same action of bending? However this may be answered, the fact remains that a large number of defects of this character have been discovered and are on record; but generally they are found close to the edge of the inner overlap of the seam. Another question presents itself in this practical case: Would not the thrust of the upper furnace stay-bolts, moving the plate of the shell outward, tend to utilize the cross stays as a pivot or fulcrum around which the point C, Fig. 3, would move inward, thus causing distention of the inner fibers at the defective point? Sometimes defects located as this one is, do not assume the form shown in this case, but the wasting extends some distance above and below, thinning the plate by the formation of a furrow or groove, but always on the wet side of the plate, so far as observed or recorded.

If we find that a boiler has its shell and furnace rigidly stayed together, with the ends of stays set with round pins fitting nicely in round holes, and the stays sufficiently strong and numerous to act as struts, then every motion of the furnace will be communicated to the shell. In this particular case the number of the extreme thermal changes corresponds with the number of times that steam has been raised during a period of about 2,000 days, from May 1, 1874, to October 28, 1879. Deducting the idle days, we have a fair statement of the number of the motions due to unequal expansion. We should hardly expect to find so many stays each bearing its exact proportion of the stress, and under unfavorable circumstances of construction, they might be set so that a little additional distention or compression of the arch of the wagon-top might be accomplished with each stay, or even row of stays. The shell, which yields readily to a comparatively slight local force when not supported in form by internal pressure, would certainly suffer such distortion of form as would place it in a very unfavorable condition to sustain the pressure of steam in addition to the thrust of the expanding furnace.

The millions of motions or vibrations communicated to every part of a locomotive boiler by the concussions of the wheels, the intermittent flow of steam to the cylinders, and the shocks of coupling and derailment no doubt contribute something, and in a weakened structure they may be very considerable agents of destruction; but they need not be invoked in this case. They are incidents in the life of all active locomotives, and thousands wear out and are laid aside or cut up without exploding.

Device for Walking on Water.

W. C. Soule patented an invention for walking on water a year ago, and recently gave an exhibition of his apparatus on the Harlem River. It consists of two "shoes" of thin zinc, 5 feet long, 10 inches wide and

5 inches deep. There is a socket in the center of each for depositing the foot, but around that socket the shoe is hollow and air-tight. It sinks about 4 inches when stepped in. Underneath at each end is an automatic paddle 7 inches deep, shaped like a Venetian blind. When moving forward, the blades open in order to afford no obstruction to the water, but in pressing the shoe back they close; this gives a purchase for the rear leg, which enables the fore leg to advance. Mr. Soule at first walked across the river in street clothes, but afterward, when in a bathing suit, pushed the shoes into the stream, swam and floated in a sitting posture. He was led to the invention by a desire to follow snipe in Wayne county, where he was reared. The shoe enabled him to penetrate wooded swamps, where the water was often too deep for wading, and where a boat would have been useless. He found them also to afford a comfortable seat in fishing.

The United States at the Fishery Exhibition at Berlin.

The United States have carried away a lion's share of the honors from the Berlin Fish Exhibition. The American display has been so enthusiastically praised by all the foreign newspapers, that an official commendation was to be expected; nevertheless the result is surprisingly gratifying. The "grand prize of honor," given by the Emperor "for the most complete exhibit of all departments, and especially in fish culture and its improved apparatus," is awarded to Prof. Spencer F. Baird, Commissioner of Fish and Fisheries of the United States, while gold medals with honorary diploma are awarded the United States Coast Survey for its charts and illustrations of deep-sea observations, and to the United States Commission of Fish and Fisheries, of which Prof. Baird is the head, for its collective exhibition. Gratifying as this is, it does not mark the extent of our officials' triumph. In the separate competition in apparatus for fish culture, no less than eight prizes come to this country. The United States Assistant Commissioner at Bucksport, Me., Mr. Atkins, receives a gold medal for models of American fish-ways and of the salmon-breeding appliances at that post; the assistant at Baltimore, Mr. Ferguson, who is also Commissioner of Fisheries for Maryland, has a gold medal for shad-hatching appliances; Mr. Stone, Assistant Commissioner at Charlestown, N. H., a gold medal for another set of apparatus, and Mr. Mather, who is stationed at Newark, N. J., a gold medal for hatching apparatus, and a bronze medal for an invention for transporting live fishes at sea. Two State Commissioners also, Mr. Seth Green, of New York, and Mr. McDonald, of Virginia, are awarded gold medals in this class, making altogether ten gold medals carried off by American pisciculturists. In addition to these, the United States Fish Commission receives a silver medal for a display of fishermen's clothing, tents and implements, and Prof. Goode, an Assistant Commissioner, and curator of the National Museum, a silver medal for a collection of charts. The taxidermist and the photographer of the Smithsonian Institution are each awarded a bronze medal, and honorable mention is made of some improvements in the accessories of fishing vessels exhibited by Captain Collins, Assistant Commissioner at Gloucester, and of the charts of the United States Hydrographic Office and the Engineer Bureau. These are only the awards to United States officials. It would take too much space to mention all the medals given to American fish products, fish oils, canned salmon, pickled oysters, boneless codfish, etc. There are twenty silver medals in all, and fourteen of bronze, with sixteen honorary diplomas, a large proportion of which are for canned preparations and other peculiar American inventions for popularizing fish-food. It should be mentioned, however, that a Bangor man gets a gold medal for bamboo fishing-rods, and one of the silver medals is for fish-hooks, knives and the like, and another for a canoe. That our manufacturers should make a good showing in any international competition might be taken for granted; that our officials should carry away so large a share of honors is more noteworthy, and it furnishes another illustration of what has been often shown before—that in those departments in which the government service is necessarily permanent and free from the curse of politics, it is the equal of any in the world.

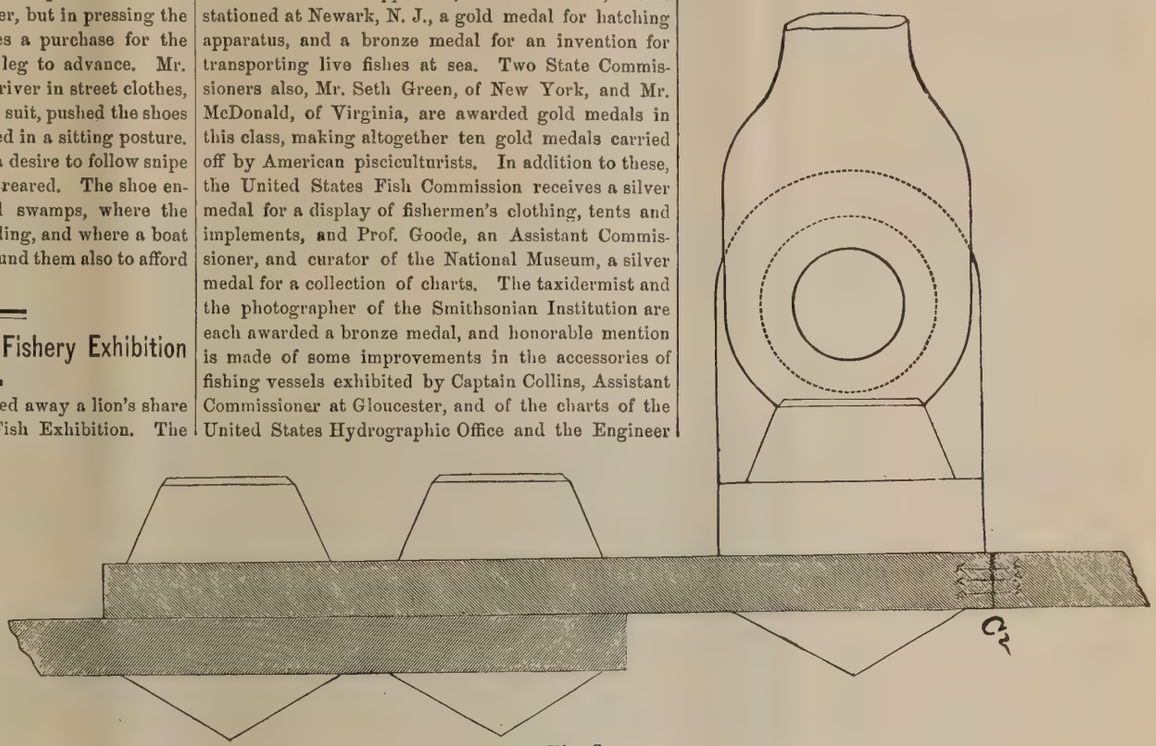


Fig. 3.

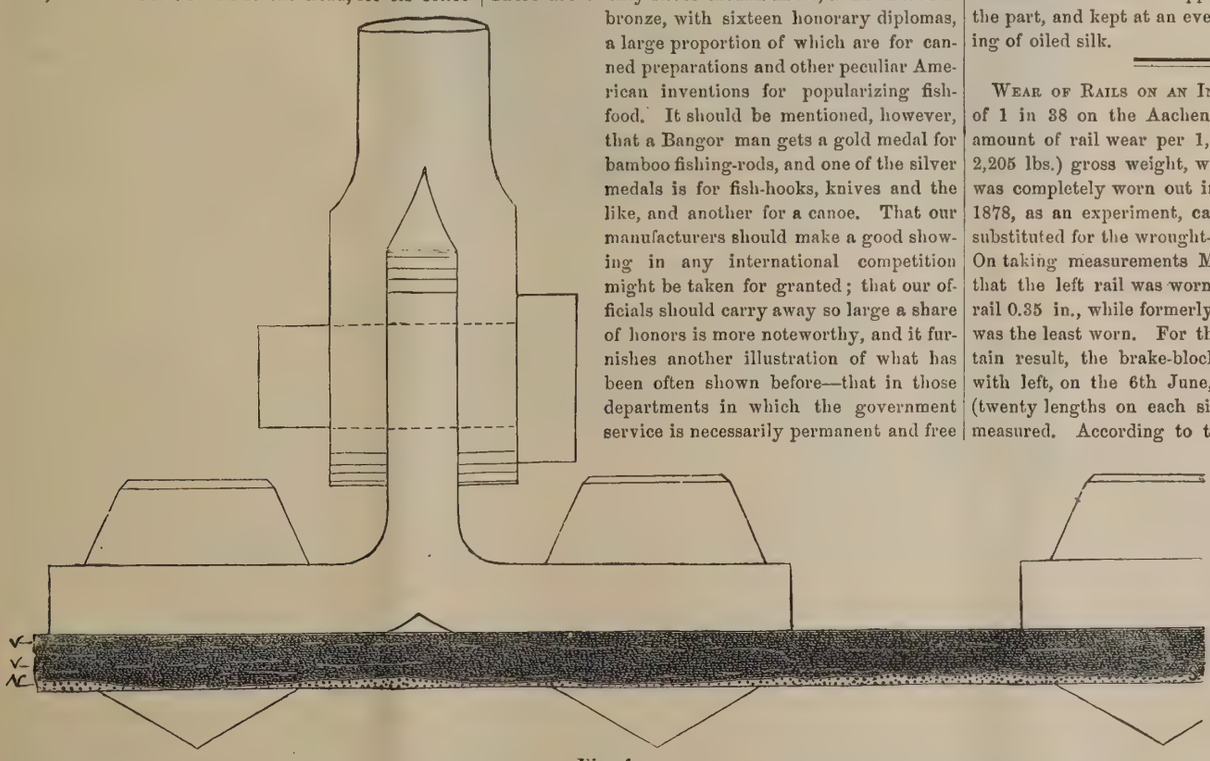


Fig. 4.

Warm Water in Surgery.—Dr. Goelet reports cases of traumatic erysipelas, lacerated and contused wounds in general, but especially those of the scalp, compound fractures, gunshot wounds and traumatic gangrene, treated by warm water application. This may be done, he says, (1), by a warm-water bath, when the limb is submerged in water kept constantly at the same temperature—some 100° Fahrenheit—disinfected when so desired, and changed as often as necessary, say twice a day; and (2), by hot fomentations, which consist of a layer of cotton batting, or two thicknesses of sheet lint, saturated with hot water—previously disinfected if desired—applied closely and evenly to the part, and kept at an even temperature by a covering of oiled silk.

Wear of Rails on an Incline.—On a down grade of 1 in 38 on the Aachen Railroad in Germany, the amount of rail wear per 1,000,000 kilometric tons (of 2,205 lbs.) gross weight, was 3,059 in., so that a rail was completely worn out in five years. On Aug. 10, 1878, as an experiment, cast-steel brake-blocks were substituted for the wrought-iron ones on the left side. On taking measurements May 6, 1879, it was found that the left rail was worn down 0.287 in., the right rail 0.35 in., while formerly the rail on the right side was the least worn. For the sake of obtaining a certain result, the brake-blocks were exchanged, right with left, on the 6th June, and the hight of the rail (twenty lengths on each side of the track) carefully measured. According to the measurements made on September 18 and November 24, 1879, the wear on the steel brake-block side amounted to 0.05 in.; on the side where the wrought-iron blocks were used, 0.086 in. per million tons gross load. On a down grade of one in seventy-five between Meissen and Muhlheim, the rail wear, with a gross load of thirty-four million tons, amounted to 0.507 in. in eight years. The chief engineer of the road can only attribute the enormous amount of wear to the fact that the soft wrought-iron blocks hold the wheels perfectly tight; while the hard steel has not such a grip on them, they occasionally slip round, and less friction results to the track.

The Reflection of Light.

The tranquil surface of a lake or pool which gives back a faithful image of the landscape upon its borders, of the sky with its clouds and stars, and of the vessels that sail over its surface, affords us the commonest illustration of what physicists call the "reflection" of light—a phenomenon whose laws and applications will provide us with material for an interesting chapter for our amateur readers.

The reflection of light from the surfaces of bodies on which it falls, is by no means uniform, but depends upon the nature of the reflecting surface and its condition. To present the phenomenon of reflection most perfectly, the surface receiving the light should be smooth, uniform and highly polished. Such surfaces, for example, are those of liquids in a state of rest—or such as are capable of acquiring this condition by mechanical means, as glass, the metals, etc. When light falls upon such surfaces, it is thrown off in accordance with well established laws, just as a ball rebounds from a hard floor. The reflection from such surfaces will not show the body of the reflecting surfaces, but the illuminated or luminous objects which are situated in front of them and which they reflect. Light reflected in this manner produces the images of these objects, the dimensions and forms of which will depend on those of the reflecting surface, but in proportion as the degree of polish is more perfect the distinctness and color of the reflected objects will be better reproduced.

It may be stated here that there is no such thing as a perfect reflecting surface. When light falls upon dull, tarnished or rough surfaces, it produces no image, but they scatter the light in all directions, and thus become visible; such bodies are said to disperse light. The light which even a highly polished surface receives is never entirely reflected. If the body be transparent or translucent, a certain portion of the received light penetrates into the interior, traverses the substance, and may be partly emitted on the other side, or altogether absorbed. Usually it is only a small portion of the luminous rays that are reflected from the surface.

Where the body is opaque, and the surface is a good reflector, the reverse takes place, and the light received is in great part reflected.

We will next consider the path which light follows in the phenomenon of reflection, always supposing the medium to be homogeneous; and for this article we shall confine our considerations to plane surfaces. By very simple experiments, which any of our readers can verify with more or less accuracy, we shall be able to indicate the laws which govern this phenomenon.

The experiment illustrated by Fig. 1 has been specially devised for the experimental demonstration of these laws. It consists of a bath of mercury for a reflecting surface and a star for the luminous object—since its rays, coming from a distance, which is practically infinite, may be considered to be exactly parallel. The direction of the rays coming from the star and falling on a certain point of the mirror formed by the mercury, is readily determined by means of a theodolite, the axis of which is fixed in a position exactly vertical (see Fig. 1). If, now, we look directly at the star, the line I′ S′ of the telescope indicates the direction of the incident luminous rays, and the angle S′ I′ N′, equal to the angle S I N, is called the angle of incidence—that is, the angle of incidence is the angle formed by a luminous ray with the perpendicular to the surface at the point of incidence.

In order to find the direction of the reflected luminous rays, we must turn the telescope on its axis until we see the image of the star on the surface of the mercury bath. When the image is brought to the center of the telescope, it is certain that the angle R′ I′ N′ is equal to the angle of reflection N I R. Thus, by reading the measure on the graduated circle of the instrument, the angle of reflection can be compared with the angle of incidence. Now, whatever may be the star observed, and whatever its hight above the horizon, it will always be found that there is a perfect equality between these angles. Moreover, the position of the circle of the theodolite, which permits the star and its reflected image to be seen, evidently proves that the ray which arrives directly from the luminous point, and that which is reflected at the surface of the mercury, are both in the same vertical plane.

We have thus demonstrated two laws which govern the phenomenon of reflection: 1st. The angle of incidence is equal to the angle of reflection; and, 2d, the incident and the reflected ray are both in the same plane, which is perpendicular to the reflecting surface. These two simple laws suffice to explain some very complicated phenomena, and the action of a number of optical instruments, wherever these phenomena and instruments have reference to the reflection of light. In strict obedience to these laws, a mirror with a plane surface—such as a looking-glass or a liquid surface in a state of rest—show images which faithfully represent the objects which they reflect. The dimensions, form and color are reproduced with the utmost exactness; the image alone is always symmetrical with the object, the right side of one being the left side of the other, and *vice versa*; and the apparent distance of the image behind the mirror is precisely equal to the real distance of the object in front of the mirror.

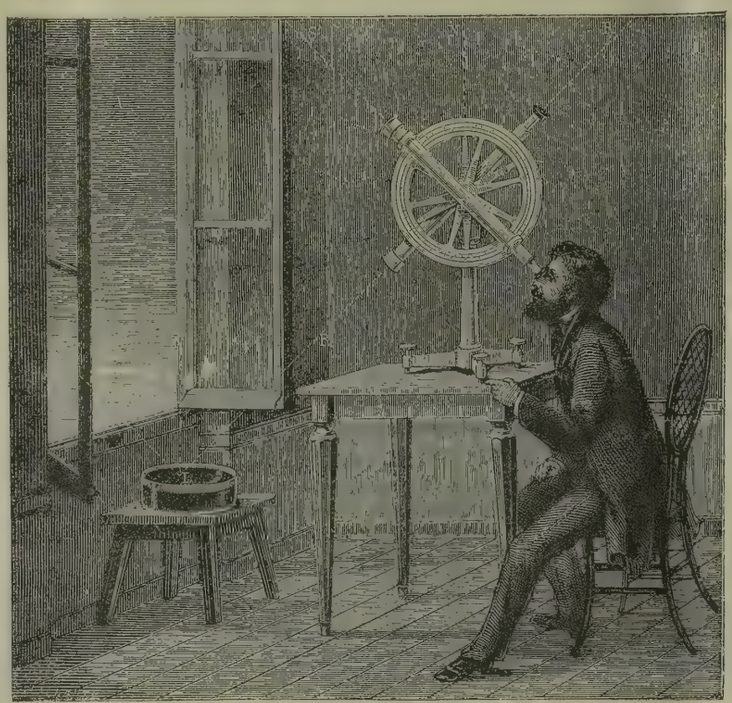


Fig. 1.—Demonstration of the Laws of Reflection of Light.

When the light, instead of falling upon a plane reflecting surface, falls upon a curved surface, the laws above enunciated remain the same for each point of the mirror—that is to say, the angles of incidence and reflection are always equal at each point on either side of the perpendicular to the plane tangent in the point; and the incident ray, reflected ray and the normal are in the same plane. But the curvature of the reflecting surface modifies the convergence or divergence of the luminous rays which after reflection enter the eye. Hence it follows that the images of luminous bodies, formed by reflection from such curved surfaces, vary in form, distance and position with the form of the reflecting surface. The study of the effects of reflection from spherical, cylindrical, conical and other curved surfaces, must form a chapter by itself, which we may present in a future article. We shall for the present conclude by presenting some noteworthy examples of the application of the principle of reflection from plane surfaces.

Fig. 2 illustrates an apparatus which has been termed the "Magic Mirror," and, as will be seen by inspection, consists simply of a combination of two plane mirrors, so inclined to each other as to enable the spectator, by glancing into one of them, to see the images of objects separated from direct view by intervening obstacles. It is used, under the name of the Polemoscope, during sieges, to observe the position and movements of the enemy, while the soldiers may remain in shelter behind a parapet. A simple framework of wood supports at the top a plane mirror, with its reflecting surface directed towards the scene to be observed, at an angle of 45°; beneath this mirror is a second one, precisely similar, and with its reflecting surface inclined upward at the same angle as the upper one. The reflecting surfaces of the two mirrors are, therefore, opposite to each other, and parallel. It is, therefore, obvious that the image received upon the first mirror must be reflected directly upon the second, from which it becomes visible to an observer, as shown in the cut.

Fig. 3 represents a modification of the same apparatus, the operation of which is made somewhat puzzling by a multiplication of mirrors. It is sometimes called the "Magic Telescope," and apparently enables one to see the images of distant objects through a stone or other interposed obstacle. From our foregoing explanations and an inspection of the figure, the mystery is easily explained. It consists of a divided tube, and between the divided parts is placed a stone or other opaque body. The mystery consists in the fact that the two divided pieces are really united by tubes in the supports (which are concealed), bent twice at right angles, and containing four plane mirrors inclined at an angle of 45°, as shown in the figure. The luminous rays from a distant object or landscape, therefore, which enter the outer end of the instrument, are reflected from the first inclined mirror to the second, from that to the third, from that to the fourth, and finally enter the eye of the spectator—thus passing around the stone, and not through it, as would appear to be the case.

Other instruments of great importance, and which are likewise based on the reflection of light from plane surfaces, in constant use, are the heliostat, by which the sun's rays are reflected in one invariable direction in spite of the rotation of the earth; the sextant, by which the navigator measures the angular distance between two objects—a star and the moon's edge, for example; the goniometer, by which the angular relations of the sides of minute crystals of mineral substances are measured; and the heliograph, by which signals, according to any prearranged code, may be flashed from station to station, often for a distance of 50 miles.

Preserving Timber.

The importance of a good method of preserving timber from decay, says the *Contract Journal*, is evident to everybody, and especially to contractors who not only erect new houses, but repair and pull down old ones. Divers plans for warding off rot are followed in different countries. In Holland, for example, a coating of pitch and tar, mixed with sea shells, sand, or iron scales from the smithy forge, is applied to the timberwork of canals, and answers very well; while scorching wood till the surface is charred is a well-known method in this country. But all external paints and

coatings are inferior to the chemical processes of preserving timber, which are based on the expulsion of the natural sap of the tree from the pores of the wood, and the impregnation of an antiseptic chemical liquid in its place, or by injecting a liquid which will "kill" the sap, as it were, and prevent it from decomposing within the timber.

We shall first glance at the best of the old methods, and then proceed to describe in detail a new method which has come under our observation.

Kyan's process, or kyanizing, brought out in 1832, consists in steeping the wood in a solution of bichloride of mercury, or corrosive sublimate, as it is popularly called; but it has not been extensively adopted, owing chiefly to the expense of the material and the fact that is does not succeed unless the timber is very dry. Another very serious objection to it, is the highly poisonous nature of the salt, a property which, though very serviceable in preventing the ravages of white ants, should quite taboo kyanized timber for the building of human dwellings.

Chloride of zinc solution has been used in the same way as the chloride of mercury—that is, by simple immersion. It has also been used as an injection into the pores of the wood, after the manner of Boucherie's process. It was introduced by Sir William Burnett in 1836, and, though far less objectionable than kyanizing on the score of its poisonous nature, it is rather apt to wash out with rain, and is therefore not suitable for exposed structures.

A great variety of other processes have been tried, too numerous to mention, but all without success, except the familiar Boucherie process and creosoting. Boucherizing consists in injecting a solution of 1 pound of sulphate of copper (blue vitriol) to 5 gallons of water, into the pores of the wood under a great pressure, which is produced by elevating the cistern containing the body of the liquor on a scaffold 24 feet above the ground. It is usual to inject about ½ of a pound of sulphate to every cubic foot of timber. For this purpose, only quick-growing, soft timber is really suitable, larch being very difficult to inject; and it has often happened that the heart-wood which is not penetrated by the solution, has rotted in a Boucherized pole, while the sapwood which has been penetrated has remained sound. Spruce and Scotch fir are very suitable, however, for the process, and are then more durable than more expensive woods unprepared. The action of the sulphate of copper in preserving the wood, is to destroy the decaying tendency of the sap within the pores. To prevent the pores closing by shrinkage, the wood should be Boucherized as soon after it is cut as possible. It is best to erect the apparatus in the forest and inject the trees the same day they are felled. For the same reason, the process succeeds best in spring and autumn, the sap being then most fluid and the pores most open. Cold hinders it, and frost stops it entirely, therefore it should not be attempted in winter.

It has been found that Boucherized wood is only partially successful for timber let into a sandy or peaty soil. Iron-work in contact with it is apt to corrode, too, owing to the iron changing places with the copper, and forming sulphate of iron; and railway sleepers of Boucherized beech, laid in Belgium, were found to rot under the iron chairs and spikes because of this chemical action. Nails used in this class of timber ought, therefore, to be galvanized, and as zinc too is liable to the same kind of corrosion, they had better be tarred over.

The apparatus required for Boucherizing is inexpensive compared with creosoting apparatus, and can be employed by a private contractor; but creosoting requires to be done at a special factory. Of all modes of preserving timber, creosoting is the most durable. Creosoted timber does not corrode iron, nor fail in any kind of soil, and it repels all sorts of pernicious insects. The creosote oil should be injected at the specified pressure, it should be free from water, and 8 pounds of it should be forced into each cubic foot, otherwise the wood will be imperfectly prepared.

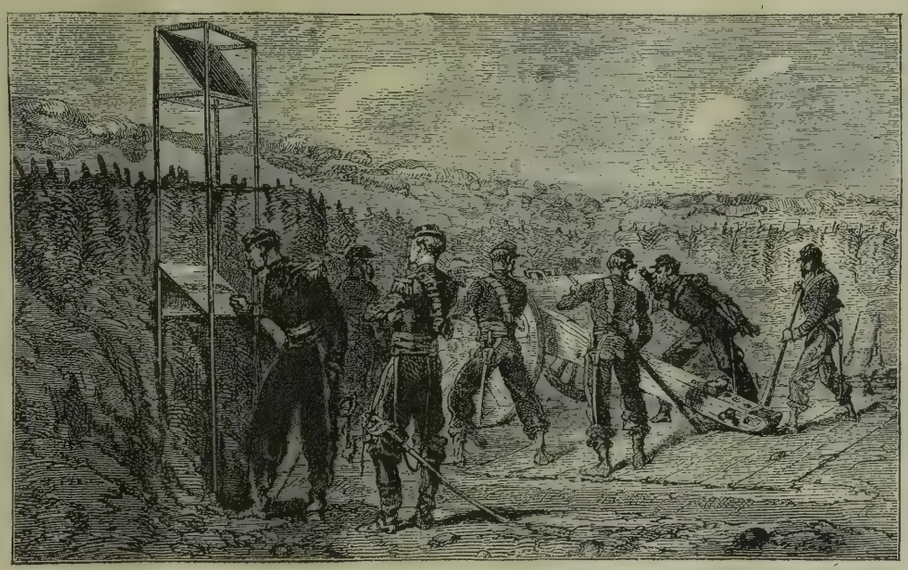


Fig. 2—The Polemoscope.

What we may Come to.

Proctor, writing in his latest volume—"The Flowers of the Sky"—remarks: "It is no longer a mere fancy that each star is a sun—science has made this an assured fact, which no astronomer thinks of doubting. We know that in certain general respects each star resembles our sun. Each is glowing, like our sun, with an intense heat. We know that in each star processes resembling in violence those taking place in our own sun must be continually in progress, and that such processes must be accompanied by a noise and tumult, compared with which all the forms of uproar known upon our earth are as absolute silence. The crash of the thunderbolt, the bellowing of the volcano, the awful groaning of the earthquake, the roar of the hurricane, the reverberating peals of loudest thunder—any of these, or all combined, are as nothing compared with the tumult raging over every square mile, every square yard of the surface of each one among the stars."

He proceeds to describe, with considerable circumstantiality, the two appearances witnessed in the heavens within the last few years—that in 1866, when a tenth magnitude star in the constellation of the Northern Crown, suddenly shone as a second magnitude star, afterward rapidly diminishing in luster; and that in 1876, when a new star became visible in the constellation Cygnus, subsequently fading again so as to be only perceptible by means of a telescope.

After noting the conclusions deduced from the application of the most improved instruments to these observations, he remarks: "A change in our own sun, such as affected the star of Cygnus, or that other star in the Northern Crown, would unquestionably destroy every living creature on the face of the earth; nor could any even escape which may exist on the other planets of the solar system. The star in the Northern Crown shone out with more than eight hundred times its former luster; the star in Cygnus with from five hundred to many thousand times its former luster, even if we take the highest possible estimate of its brightness before the catastrophe, or consider that it may have been very much brighter. Now, if our sun were to increase tenfold in brightness, all the higher forms of animal life, and nearly all forms of vegetable life, would inevitably be destroyed on this earth. A few stubborn animalcules might survive, and possibly a few of the lowest forms of vegetation, but naught else. If the sun increased a hundredfold in luster, his heat would doubtless sterilize the whole earth. The same would happen in other planets. Science knows nothing of spontaneous generation, and believers in revelation reject the doctrine. Science knows nothing of the creation of living forms, but believers in revelation accept the doctrine. Certain it is that if our sun ever undergoes the baptism of fire which has affected some few among his brother suns, one or the other of these processes (if creation can be called a process) must come into operation; or else our earth and its companion worlds would forever after remain devoid of life."

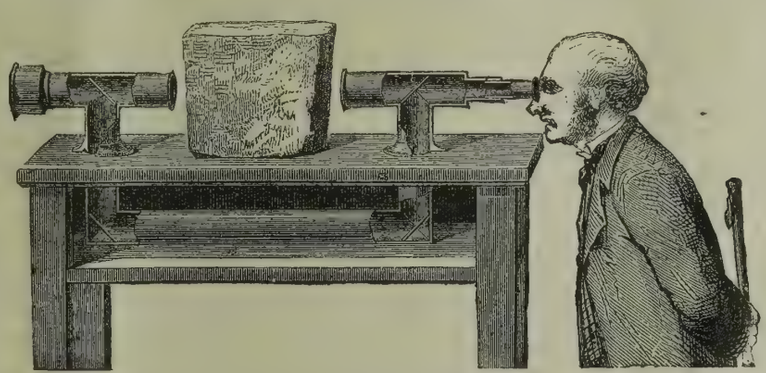


Fig. 3.—Magic Telescope.

The Mineral Riches of Japan.

The Japanese have now a completely organized geological survey, with a full staff of native surveyors, under an American chief, Mr. B. S. Lyman. The first report of progress of this survey, for 1878 and 1879, has just been published, and contains some accurate and valuable information on the mineral wealth of the country.

Mr. Lyman describes a survey journey which he made with some of his staff, from June, 1878, to February, 1879, extending over a distance of 2,800 miles. He reckons that the coal fields of Western Japan contain about 620,000,000 tons, and if one-third be deducted for the working, there will remain 400,000,000 tons, representing a value of $1,000,000,000. Inconsiderable as this is in comparison with the large and rich coal fields of other lands, it is quite equal in value to all the metal products together, except iron. The copper of all the workable mines scarcely reaches the value of $750,000,000; the eight or ten gold and silver mines, which were formerly worked and may be

so again, may, including the lead, antimony and tin mines, the workability of which is doubtful, be valued at no more than $250,000,000. On the other hand, the value of the iron amounts to at least $250,000,000,000, or 250 times more than that of the coal.

The relative importance of the mineral products of Japan (excluding Yesso and the small coal fields of Kii, Ise and Iwaki) may be represented by the following numbers: Iron, 1,000; coal, 4; copper, 3; and all other metals (chiefly gold and silver), 1. The total value of these products reaches the sum of about $252,000,000,000—that is, just as much as the coal fields of Yesso, which in other respects is so poor in natural products.

Mr. Lyman gives some details concerning twenty-four of the hot springs in Shimotsuke, Iwashiro, Uzen and Ugo, and a table of the petroleum springs of Japan, according to which by far the most numerous and productive are in Echigo and in Akita Kem, and the total delivery in the year 1879 was 4,525 gallons per day.

Scientific.

How Hannay Made his Artificial Diamonds.—It will be fresh in the memory of some of our readers, that a few months ago a statement was made to the effect that diamonds had been artificially produced in Glasgow by a process not yet divulged, and that, having been examined by the highest chemical and mineralogical authorities, the new gems had been found to satisfy all the conditions hitherto alone supplied by the diamonds from nature's own laboratory. When, however, it became known that the new diamonds were almost microscopical, and that a gem worth $2.50 cost $25 to make, the interest in the subject somewhat diminished.

It has, however, revived on the publication by Mr. G. B. Hannay, in the recently issued number of the "Proceedings of the Royal Society," of the precise method by which he obtained his startling and novel results, from which we are enabled to glean the following interesting facts, and if only as a record of indomitable perseverance against ever-increasing difficulties, of scientific acumen, and of the true application of the Baconian method of research, it is worthy of study. Some idea of the nature of the investigation may be obtained from the fact that out of 80 complex and expensive experiments, only 3 succeeded. Violent explosions were frequent; furnaces were blown to pieces; steel tubes burst, scattering their fragments around. On other occasions, tubes which had been carefully prepared, filled, welded, and nested in a reverberatory furnace for many hours, were found to have leaked and spoiled the experiment. "The continued strain on the nerves," writes Mr. Hannay, "watching the temperature of the furnace, and in a state of tension in case of an explosion, induces a nervous state which is extremely weakening, and when the explosion occurs it sometimes shakes one so severely that sickness supervenes."

The diamond-making experiments were started in September, 1879, when Mr. Hannay made many attempts to find a solvent for the alkali metals, sodium, potassium, and lithium. But in no instance could such a solvent be found which did not, in the gaseous state, and under pressure, unite with the alkali. Even in the case of hydrocarbons, such as paraffine spirit containing only hydrogen and carbon, the alkali combined with the hydrogen, setting free the carbon. Now, as we know, diamond is pure carbon; hence, when this element was set free from a pure substance, it was thought that conditions of pressure and temperature might eliminate it in the hard, crystalline, adamantine form—namely, as diamond. Glass tubes were at first employed, but although of great thickness in comparison with their bore, they were found to be insufficiently strong, and were replaced by wrought-iron tubes 20 inches long by 1 inch diameter, and having the diameter of the bore half an inch. In these lithium was heated for many hours to a high temperature in paraffine spirit, and on subsequently opening the tube, carbon in a hard form was found within it. Great difficulty was experienced in getting the tubes perfectly air-tight, and eventually the open end was welded at a white heat, and by that means alone did it resist leakage. Sometimes tubes would burst with an explosion like a gun. A tube 20 inches long by 2¾ diameter and ½ inch bore, was filled with a hydrocarbon made from bone oil, to which some charcoal powder was added in order to keep an excess of carbon in the tube. Its open end was welded, and it was heated for 14 hours with lithium. On opening it, a quantity of gas appeared and some minute pieces of hard carbon which had evidently separated out from solution. Another similar tube burst at the end of 8 hours' heating. A tube of cast iron no less than 3¾ inches diameter, and with a bore of only ¾ of an inch, exploded at the end of an hour with a fearful report, wrecking the furnace. Several tubes of steel also burst under the enormous pressure, at last shattering the top of the furnace. The author remarks that in nature the temperature must at one time have been much higher than anything we can now produce artificially, while the pressure obtained at a depth of 200 miles below the earth's surface is greater than that which any of the materials from which we can form vessels can resist.

We come now to the great experiment which resulted in the artificial production of veritable diamonds. A tube 20 inches long by 4 inches diameter, of coiled Lowmoor iron, was bored so as to have an internal diameter of ½ an inch. Thus the central bore was surrounded by walls of iron 1¾ inches thick, and, of course, capable of resisting an enormous pressure. In the tube was placed a mixture of 90 per cent of bone oil and 10 per cent of paraffine spirit, together with 4 grammes (about 62 grains) of the metal lithium. The open end of the tube was welded air-tight, and the whole was then heated to redness for 14 hours, and allowed to cool slowly. On opening it a great volume of gas rushed from the tube, and within was found a hard, smooth mass adhering to the sides of the tube. "It was quite black," states the author," and was removed with a chisel, and as it appeared to be composed principally of iron and lithium, it was laid aside for analysis. I was pulverizing it in a mortar when I felt that some parts of the material were extremely hard—not resisting a blow, but hard otherwise. On looking closer, I saw that these were transparent pieces imbedded in the hard matrix, and on triturating them I obtained some free from the black matter. They turned out to be crystalline carbon, exactly like diamond."

Such is Mr. Hannay's account of his discovery. Subsequent chemical and optical analysis has proved that these hard, shining crystals are in every respect true diamonds. The cost is obviously great; so also is the danger to life and property, and the great difficulties to be overcome render disappointments common. What we now want is to get vessels of a material sufficiently strong and non-porous to resist the high pressures and temperatures upon which the success of the experiment depends. What we have learned, among other things, from the brilliant researches of MM. Caillelet and Pictet, which led to the liquefaction of the so-called permanent gases, and from Mr. Hannay's experiments, described above, is that we must push the forces of nature to their utmost strain by using our most powerful mechanical devices for producing pressure, our strongest materials for resisting it, and our intensest means of producing both heat and cold.

The Microscope in Botany.—The microscope is constantly enlarging its field of usefulness, and is adding, day by day, new triumphs in the direction of original research. It has recently given to the world a new and more certain mode for determining the geological structure of rocks; and the fact is now announced of a discovery of equal importance in connection with the life and growth of plants. As, in the first case, many of the universally accepted theories of geologists were brushed aside, so, in the present instance, theories which botanists had supposed to be well established are completely overthrown.

It appears that Prof. Prinzheim, of Berlin, has recently been studying the green coloring matter in the leaves of plants, known as chlorophyl, and the cells in which it is contained. Botanists have heretofore assigned to this substance the work of absorbing from the atmosphere, during the night, carbonic acid gas, retaining the carbon for the sustenance and growth of the plant, and returning the free oxygen to the air to make good the deterioration of that element through the respiration of the animal creation. Now Prof. Prinzheim has demonstrated, by the aid of the microscope, that chlorophyl does not perform that work, but that the carbon in the atmosphere is appropriated and assimilated through the medium of a balsam-like substance in the plant, heretofore unknown, to which he gives the name Hypochlorine. This newly discovered substance, when under the influence of sunlight, has a strong affinity for carbonic acid; and it further appears that the heretofore supposed active chlorophyl is merely a passive agent—a sort of curtain, screening the hypochlorine from the direct or too powerful influence of the sun's rays, so that it may do its work with regularity and moderation. The professor has shown, by experiment, that if the intensity of the sun's rays is materially increased by any optical apparatus, the chlorophyl screen or regulator is found too feeble to protect the hypochlorine in its proper work, and oxidation sets in so rapidly that both chlorophyl and hypochlorine are rendered inert, and the plant dies. This discovery opens an entirely new field for botanical research, and furnishes additional evidence that plants have a regulator of vital forces, corresponding more nearly than the simple chlorophyl to the heart and lungs of animals, and further proof is gained in the direction of a unity of life between the animal and vegetable kingdoms.

Effect of Polarization upon Friction.—Herr Koch has made an interesting experiment showing the effect of polarization upon friction, the result appearing to have a bearing on the action of the Edison friction telephone. When a plate of platinum or palladium is polarized by means of an electric current, the friction of these metals against a plate of moistened glass increases immediately. To measure the friction, Herr Koch uses the metal in the form of a hemispherical button, resting on the bottom of a glass cup filled with pure or acidulated water. The button serves as a pivot to a magnetic needle, which oscillates under the action of the earth; the decrease of the oscillations measures the friction of the pivot. Polarization is produced by the current of the Daniel element, one pole of which communicates with the metallic button, while the other terminates with a platinum wire entering the water of the cup. The polarization by hydrogen produces no effect, but polarization with the pole oxygenated is found very efficacious. The friction was increased, through this polarization, in the ratio of 2 to 3, and sometimes in that of 2 to 4. This increase of friction appears immediately after the circuit is closed, and disappears immediately when the current is reversed; but it disappears slowly, like the polarization itself, when the circuit is merely opened. Palladium behaves like platinum. Gold gave no effect.

The Jamin Electric Light.—In Paris the electric light appears to be making rapid progress in gaining public favor. The latest success is said to be the Jamin electric light, which was exhibited recently before a distinguished audience. The distinctive feature of this system consists in the arrangement of the circuit of the connecting wires, by which the electric currents transmitted through them exercise a deflective action upon the arc which is passing between two sticks of carbon. The arc is projected on to a ball of lime or zirconia, which is thus brought to a state of intense incandescence. To obtain this deflective action, the main circuit is carried several times around a rectangular loop of wire, which is fixed at a convenient distance from the carbon pencils in the

same vertical plane. The candle has two vertical rods, which differ from the Jablochkoff in that there is no insulating material between them. They are suspended in sockets, one of which is pivoted so that a small electro-magnet controlling it can maintain automatically the proper distance between the two ends. The main advantage of the new system, is that the candles can be lighted or extinguished at will, and their intensity can be easily varied singly or altogether.

The great popularity in England and on the continent of skating rinks, has had the effect of stimulating inventive talent in the improvement of the electric light.

New Minerals.—*Fredericite*, a new sulpharsenide, allied to tetrahedrite, but containing lead and tin in notable proportions. It only occurs massive. Color, iron-black; H=3.5; specific gravity, 4.65. It is described as a new species by Sjögren as occurring with galenite and geocronite at the Falu mine in Sweden.

Orizite.—Considered by its discoverer, Grattarola, to be a dimorphous form of heulandite, with which zeolite it is identical in composition. It occurs in crystalline grains or minute crystals, having the color and luster of rice grains. Occurs in the granite of San Piero, in Campo, Italy.

Pseudonatrolite.—A new zeolite, occurring in minute crystals, presumed to be orthorhombic. H=6; luster, glassy to pearly. Same discoverer and same locality.

Mallardite.—A hydrous sulphate of manganese, found by Carnot crystallized in a gray clay-like vein stone with quartz and barite, at the Lucky Boy Silver Mine, Butterfield Cañon, Utah. Colorless when fresh, but when exposed to the air, effloresces, and becomes opaque.

Luckite.—Same locality and discoverer. Occurs in bluish striated prisms in a bituminous rock. Crystallization probably monoclinic. Composition identical with that of mallardite, save that it contains 21.7 per cent of ferrous oxide.

Guejarite.—A new sulph-antimonide of copper, found with siderite in the copper veins of Guejar, Andalusia. Color, steel-gray; crystallization, orthorhombic. It is related to chalcostibite. Described by MM. Cumenge and Friedel.

Beccarite.—A variety of zircon from Ceylon. Described by Grattarola.

Mixite.—A hydrous arsenide of copper and bismuth, occurring with bismuthite and torbernite, at Joachimsthal. An emerald to bluish-green mineral, found as an incrustation in bismuth-ocher; also in granular and massive particles, sometimes spherical in form and partly crypto-crystalline. Described by Schrauf.

Perforating Glass by Electricity.—In *La Nature*, M. Fagas describes a simple method of perforating glass by means of the electric spark. The apparatus required consists of a rectangular plate of ebonite, its size being, for a coil giving 4¾-inch sparks, about 7 by 4¾ inches. A brass wire passes under this plate and has its pointed end bent up and penetrating through the plate—no further. This wire is connected with one of the poles of the coil. A few drops of olive oil are placed on the ebonite plate about the point, and the piece of glass to be perforated is laid upon it, care being taken not to imprison any bubbles of air. The olive oil perfectly accomplishes the object of insulating the wire. All that is necessary is to bring down a wire from the outer pole of the coil, on the piece of glass above the point of the lower wire, and pass the spark. By displacing the glass laterally for successive sparks, it is easy to make a close series of holes in a few seconds.

Glycerine as an Illuminant.—Pure glycerine, it is said, may be burned in lamps, provided the wick is so arranged that it shall not be elevated above the surface of the liquid, as the viscidity of the substance will not permit of its being fed upwards by capillary attraction. The flame of glycerine, like that of alcohol, is almost colorless. Glycerine, however, is easily mixable with a variety of substances that will impart luminosity to the flame, and a number of substances rich in carbon may be added to it for that purpose. It is not improbable that circumstances might arise where these facts would be useful.

The Margin for Improvement in the Duty of Steam Motors.

A vast amount of mechanical skill has been bestowed during the past hundred years in improving the steam engine; but when we come to compare the actual duty obtained from even the best forms of engines, with the duty that theory requires that a perfect engine should yield, the margin for possible improvement will be found to be still very wide. So long as this is the case, our inventors will find it far more profitable to let "new motors" alone and direct their ingenuity to the further improvement of the steam engine.

The following simple calculation will make the status of the steam engine clear: The steam engine is an apparatus for converting heat into mechanical effect. It will be necessary, in any attempt to get at the theoretical duty of such an engine, to know at the outset just what the mechanical value of a given amount of heat is—in other words, to know the mechanical equivalent of heat. Scientific investigation has given us here just the starting-point we require, in the unit called the "foot-pound"—that is, the force required to raise a weight of one pound to the hight of one foot. Now, since we learn from the steam engine that heat and mechanical effect (or work) are convertible, if we could by any means convert mechanical effect into heat so that none of it should be lost or dissipated, we should have the data given from which to calculate the mechanical equivalent of heat. This has been done by several eminent men of science, and their experimental results have been surprisingly close. Their efforts were directed to the determination of the amount of mechanical energy required to raise the sensible temperature of one pound of water 1° Fah. This quantity, expressed in foot-pounds, gives for the mechanical equivalent of heat 772 foot-pounds.

To explain the significance of this constant in another way, we may state that the mechanical effect exerted by a body weighing one pound, that has fallen from the hight of 772 feet, would, if converted into the form of energy called heat, be just sufficient to raise the temperature of one pound of water 1° Fah.

Having established the equivalency of heat and work in measurable terms, the remaining portion of the problem is made comparatively easy. First, it is necessary to determine the perfect heating effect of the combustion of one pound of pure coal. This, too, has been done, and it has been found that the entire quantity of heat liberated by the burning of one pound of pure carbon, when applied without loss to heating one pound of water, will raise the temperature of that quantity of water almost exactly 14,220° Fah., or, what is the same thing, differently expressed, will raise the temperature of 14,220 pounds of water 1° Fah.

Now, to get the mechanical effect of this value, we have the following simple procedure: As the heating of one pound of water 1° demands the conversion into heat of a quantity of mechanical energy equal to 772 foot-pounds, therefore the heating of 14,220 pounds 1° will require the conversion of $772 \times 14{,}220 = 10{,}977{,}840$ foot-pounds, which is the mechanical equivalent of one pound of pure coal burned without waste.

To convert this value into more familiar terms of horse-power, it is simply necessary to divide it by 33,000, performing which operation, we have

$$\frac{10{,}977{,}840}{33{,}000} = 332.6 \text{ horse-power.}$$

That is to say, one pound of pure coal, burned in one minute, should, if it could be applied with absolute economy to the performance of work, develop 332.6 horse-power; or, if burned in an hour, then it should develop one-60th of this, or 5½ horse-power per hour; or one horse-power should be developed by the burning of (approximately) one-5th of a pound of coal.

The theoretically perfect steam engine, therefore, ought to yield us for every pound of coal burned, 5½ horse-power. By comparing these conclusions with the results of practice, we will see how far from perfection our steam motors really are. The actual consumption of fuel per hour per horse-power will, of course, vary largely in practice, according as the apparatus is well or badly constructed, and properly or wastefully operated. But, putting such disturbing elements aside, we will take the best results of the best practice in making a comparison. Taking marine engine practice, which gives us the best results, the best of these require from 2½ to 3 pounds of coal to develop a horse-power. As one-5th of a pound of coal should develop this mechanical effect if all its heating effect were realized, it is evident that our best steam engines are only realizing $\frac{1}{5} \div 2\frac{1}{2} = \frac{2}{25}$ths, or say about $\frac{1}{12}$, or about 8 per cent of what theory shows us should be realized. To make this comparison more just, it is proper to make allowance for the fact that the actual heating power of commercial coals, owing to their impurity, is considerably lower than the theoretical figures used in this calculation, and for other causes that lower the duty, and for which the steam engine is not responsible—making such allowance, it is reasonably safe to say that our steam motors to-day do not realize more than 15 per cent of the power that theory demonstrates to be available.

The successful demonstration of the capabilities of the Perkins high pressure system, which we recorded in our last issue, shows, however, that we are on the verge of another decided advance in the direction of greater economy in our steam motors, which bids fair, when the system shall have been fully developed, to raise the figures of practice much nearer to those of theory. The miniature steamer "Anthracite" developed, in her Atlantic trip, one horse-power per hour with one pound of coal, a performance which more than doubles that of the best engines hitherto constructed, and which will doubtless be materially improved upon when the Perkins system is applied on our large ocean steamships, where much greater economy may safely be expected. Even with this substantial gain in duty, there will still remain a wide margin for future improvement before the demands of theory are even distantly approached; and, as remarked at the outset of this article, our inventors have no need, so long as this is the case, to look about them for a new field in which to exercise their ingenuity.

A Bureau for the Verification of Thermometers.

In addition to the Horological Bureau lately established in connection with the Winchester Observatory of Yale College, to encourage the development of the horological industries, and to assist by research and otherwise the construction of refined apparatus for the measurement of time, the managers of the observatory have established a Thermometric Bureau for the verification of thermometers, which promises to be equally as useful to meteorologists, physicians and others.

The means heretofore at the disposal of the makers of thermometers in this country, to verify their delicate thermometers, have been inadequate for the purpose, since no recognized standard has been available with which to verify their scale readings by comparison. This want, which is severely felt by medical practitioners and meteorologists throughout the country, the Yale Observatory has decided to supply; and with this end in view, the managers have accepted the aid of the Bache fund of the National Academy in obtaining the standards of the foreign observatories, and have made provision for the constant determination of the errors of the standards themselves. This having been done, it only remains for us to add that the observatory now places every facility at the disposition of observers and thermometer makers for the ready verification of their instruments, charging but a trifling fee for the work, and there is, therefore, no reason why the purchaser of a thermometer should not avail himself of the opportunity to obtain an accurate knowledge

of the errors of his instrument. The observatory will make arrangements with hospitals and other institutions using a number of thermometers, for the systematic examination, at stated intervals, of all thermometers in use; and the opportunity which the bureau affords to dealers and makers of thermometers for the verification of their instruments, is manifest. The practical value of this bureau will best appear from the following announcement:

"This bureau has been established by the Corporation of Yale College, at the recommendation of the Board of Managers of the Winchester Observatory, in order to afford desired facilities for the adequate verification of thermometers. Thermometers will be received by the observatory for the purpose of comparison with the observatory standards, and certificates of comparison signed by the astronomer in charge will be issued with thermometers so compared. These certificates will contain a statement of the corrections to be applied at intervals of five or ten degrees of the thermometer scale to cause it to have the same reading as the observatory standards. In general, these corrections will be expressed in tenths of a degree Fahrenheit, or in twentieths of a degree Centigrade. Thermometers sent for verification must have a name and number engraved upon them; and thermometers which are not graduated on the glass stem, must be of sufficiently good workmanship to satisfy the observer in charge that the scale will not suddenly change with reference to the glass stem of the thermometer tube, with ordinarily careful usage. The Board of Managers have established the following scale of charges for this service, which includes the hall mark and the certificate:

Standard meteorological thermometers..	$1 00
Ordinary meteorological thermometers..	50
Ordinary maximum thermometers.....	75
Ordinary minimum thermometers.....	75
Clinical thermometers.....	50

"There will be a deduction of one-fifth of the above charges where more than eight thermometers of one kind are received at the same time. In the case of clinical thermometers, the charge will be $4 per dozen when not less than two dozen are sent at the same time. For other thermometers than the above, the charges for verification will be furnished on application. The letter of advice accompanying thermometers sent for verification should contain the maker's name, the number of each thermometer, and full directions for re-shipment. All proper precautions are taken by the Board of Managers to guard against loss or injury; but as it is manifestly inexpedient that a university corporation should be responsible for property in its care for such a purpose, it is to be understood that all risks are assumed by the person sending the thermometers. Leonard Waldo,

Astronomer in Charge."

Cooper's Mechanical Movement.

The following additional facts respecting the interesting mechanical novelty illustrated and described in our last month's issue, should have been incorporated in that article, but not having been received in time, we give it as an addendum herewith:

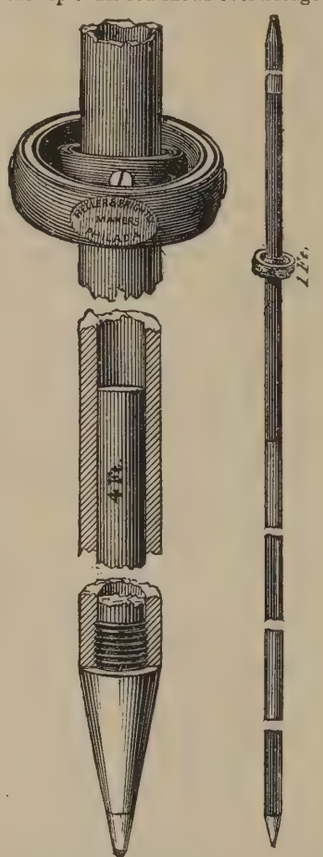
The Judges of Award at the Centennial Exhibition made the following report upon Mr. Cooper's mechanical movement: "He exhibits a method of changing continuous circular into intermittent circular motion. This invention is characterized by great originality and ingenuity, and differs from previous attempts to attain this end, in that it accomplishes it without shock, and therefore admits of being run at great speed, in which respect it is an important improvement in motion of this character."

The report in question is a high endorsement of the meritorious features of this invention. We will add, in conclusion, that any inquiries respecting the use or purchase of rights in this invention, may be addressed to John H. Cooper, 135 Wister street, Germantown, Philadelphia, Pa.

A Self-Plumbing Ranging-Rod for Transit Field Work.

Those of our readers who are interested in the improvement of engineering instruments, will read with pleasure the following account of a novel device, which, though quite simple, will prove very useful in eliminating one possible source of inaccuracy, as will appear from the description. The device was presented for exhibition at one of the late meetings of the Engineers' Club, of Philadelphia, and was described as follows by Prof. L. M. Haupt:

All engineers who have had any experience in location on rough, heavily timbered ground, will appreciate the efforts of Mr. Charles S. Heller, of the firm of Heller & Brightly, and a member of the club, to eliminate as far as possible one of the causes of inaccuracy resulting from a careless or inexperienced rodman. When, as frequently happens, the rodman is invisible and only the top of his rod shows over a ledge of rocks



Self-Plumbing Ranging-Rod for Transit Field Work.

or through a clump of trees, and the roaring of a cataract prevents his hearing a word from the transit man, it is very important that his rod should be held vertical. To accomplish this, the inventor has applied the "gimbaling" principle of the plummet lamp, used in mine surveying, to the transit rod, as shown in the accompanying figure, by substituting brass for wood, making the rod hollow, loading the bottom by filling the inside of the tube with lead to a convenient hight, and attaching gimbals at some point above the center of gravity. By means of these gimbals the rod is held by the assistant, and as soon as raised free from the ground it immediately plumbs itself, or, in other words, is truly vertical.

The rod here presented as a sample is seven feet in length, of a "hard brass" seamless tube, specially rolled so as to be perfectly straight, and extra heavy so as not to easily bend, having an outside diameter of $^{11}/_{16}$ and inside $\frac{1}{2}$ inch. It is divided into feet by the ordinary red and white bands, fire japanned, with brass cone and steel point on one end, and on the opposite end a drill for transferring centers into stone, etc. The lower four feet are filled with lead, and the gimbals are attached 6 inches above the 4-foot marks. Where, however, a greater length than 7 feet is desirable, instead of increasing the length of the main tube, which would make it unwieldy, a small tube, fitting and sliding inside of the main tube (telescoping it, as it were), allows a 12-foot length to be obtained without materially increasing the weight.

Although so slender, these rods are said to be quite as visible with the latest improved transit telescopes, which have a magnifying power of 28, as the 2-inch wooden rod is with the more imperfect combination in the telescopes formerly used, and having merely a power of 10 to 12 diameters.

These rods form an important link in the improvements demanded in surveying instruments by those desiring to do conscientious, rapid and good work, and it may not be amiss to mention that their cost is but little more than that of the wooden "ranging poles" ordinarily used.

The Proposed Illinois Ship Canal.

Mr. Daniel C. Jenne, Chief Engineer of the Illinois and Michigan Canal, gives the following account of the proposed through water route from the great lakes, at Chicago, to the Mississippi River:

The first division of the project consists in the enlargement of the Illinois and Michigan Canal from Chicago to Joliet. The present canal was built 48 feet wide on the bottom, with side slopes 1 to 1 in earth, making 60 feet surface width at 6 feet deep, or below the low water of Lake Michigan, with a descent on the bottom of one-tenth foot per mile across the summit level, toward Joliet. It is proposed to make the enlarged canal 144 feet wide on the bottom, side slopes 1 to 1 protected by slope wall in earth, and 160 feet wide at surface at 8 feet deep. The second division extends from 1½ miles above Joliet to La Salle, about 67 miles, and will consist of the improvement of the Desplains and Illinois rivers by locks and dams, and an independent short piece of canal around the rapids at Marseilles. The third division consists in the improvement of the Illinois River from La Salle to Grafton, on the Mississippi River, distance 227 miles; of this, 90 miles have been finished by the construction of two locks and dams.

COST OF THE WORK.

The estimated cost of the first division, 33 miles, is..	$11,532,932
Estimated cost of the second division, 67 miles, is...	4,327,879
Estimated cost of the third division, 227 miles, is...	1,000.000
Total cost to complete 327 miles	$16,860,811
There has been expended by the State on locks and dams.....	747,747
There has been expended by the United States on locks and dams.....	62,360
There has been expended by the United States on dredging wings, dams, etc....	526,000
Amount already expended.....	$1,336,107
Total estimated cost of the entire work.....	$18,196,918

According to these estimates, the canal (327 miles long) will cost $55,560 a mile, and will have twelve times the capacity of the Erie Canal, which cost $90,000 a mile. This route opens an inland water communication between the Gulf of Mexico and New Orleans, St. Louis and other cities of the West and Southwest, through the city of Chicago, with the city of New York in one direction, and with the cities on the St. Lawrence River and the Gulf of St. Lawrence in another direction.

The dimensions of the proposed canal are sufficient to admit boats of 2,500 to 2,800 tons burden, being 80,000 to 85,000 bushels of grain, or one and a half to one and eight-tenths million feet of pine lumber. Fleets of smaller boats can pass the locks at the same time with about the same tonnage, or twelve of the boats of the Erie Canal, or the Illinois and Michigan Canal, can pass the locks at one lockage.

A Novel Industry.—From sawdust, ground-up twigs and like materials, pails, tubs, moldings for buildings, doors, sashes, blinds, etc., are now manufactured at Great Falls, Windham, Me.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M.	$60 00 *a* 70 00
Pine, good	52 00 *a* 55 00
Pine, shipping box	20 00 *a* 22 00
Pine, common box	17 00 *a* 18 00
Pine, common box, ⅝	15 00 *a* 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	42 *a* — —
Pine, tally plank, 1¼, 2d quality	35 *a* 38
Pine, tally plank, 1¼, culls	28 *a* 30
Pine, tally boards, dressed, good	28 *a* 30
Pine, tally boards, dressed, common	22 *a* 25
Pine, tally boards, culls, dressed	22 *a* 25
Pine, strip boards, merchantable	16 *a* 18
Pine, strip boards, clear	22 *a* 25
Pine, strip plank, dressed, clear	33 *a* 35
Spruce boards, dressed	20 *a* 22
Spruce plank, 1¼-inch, dressed	25 *a* 28
Spruce plank, 2-inch,	40 *a* — —
Spruce wall strips	14 *a* — 15
Spruce timber, per M.	20 00 *a* 25 00
Hemlock boards, per M	15 00 *a* 16 00
Hemlock joist, 2½x4, each	15 *a* — 16
Hemlock joist, 3x4	16 *a* — 18
Hemlock joist, 4x6	40 *a* — 44
Ash, good, per M.	45 00 *a* 47 00
Oak	50 00 *a* 85 00
Maple culls	25 00 *a* 30 00
Maple good	45 00 *a* 75 00
Chestnut	45 00 *a* 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 *a* 40 00
Black walnut, good to choice	85 00 *a* 100 00
Black walnut, ⅝-inch	75 00 *a* 85 00
Black walnut, selected and seasoned	110 00 *a* 150 00
Black walnut counters, per ft	15 *a* 20
Cherry, wide, per M.	85 00 *a* 100 00
Cherry, ordinary	60 00 *a* 80 00
White wood, inch	45 00 *a* 55 00
White wood, ⅝-inch	30 00 *a* 45 00
White wood, ⅝ panels	35 00 *a* 45 00
Shingles, extra sawed pine, 18-inch	4 00 *a* 5 00
Shingles, clear sawed pine, 16-inch	3 75 *a* 4 00
Shingles, cypress, 24x6	18 00 *a* 20 00
Shingles, cypress, 20x6	10 00 *a* 12 00
Lath, Cargo rate	1 50 *a* — —
Yellow dressed pine flooring	30 00 *a* 37 50
Yellow pine girders	32 50 *a* 40 00
Locust posts, 8 feet, per inch	18 *a* 20
Locust posts, 10 feet	24 *a* 25
Locust posts, 12 feet	29 *a* 34
Chestnut posts, per ft.	3 *a* 3½
Basswood per M.	25 00 *a* 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	3 00 *a*	3 50
Up Rivers	4 00 *a*	4 50
Jersey	— — *a* —	—
Long Island	— — *a* —	—
Haverstraw Bay	4 75 *a*	5 00
" choice	5 25 *a*	5 50
Favorite Brands	5 75 *a*	6 00
Hollow Fire-Clay Brick	9 00 *a*	9 25

FRONTS.

Croton—Brown, per M.	10 00 *a* 11 00
" Dark	11 00 *a* 12 00
" Red	12 00 *a* 13 00
Philadelphia	— — *a* — —
Trenton	21 00 *a* 22 00
Baltimore	38 00 *a* — —
Clark's Ottawa White	25 00 *a* — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	25 00 *a* 26 00
" Glengarnock	23 50 *a* 24 00
" Eglinton	22 00 *a* 23 00
" American, No. 1	26 00 *a* 28 00
" American, No. 2	23 00 *a* 24 00
" American, forge	21 00 *a* 22 00
Store prices.	Cash.
Bar, Swedes, ordinary sizes	— 6 *a* — 6¼
Bar, Swedes, nail-rod	— 6½ *a* — —

LEAD—PER 100 POUNDS.

*German	— — *a* — —
*English, common	— — *a* — —
*Spanish	5 75 *a* — —
*Foreign, refined	— — *a* — —
*Bar	6 50 *a* — —
*Sheet	7 50 *a* — —
*Pipe	— — *a* — —
*Domestic	4 63 *a* — —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 00 *a* 3 10
8d and 9d, common	3 25 *a* 3 35
6d and 7d, common	3 50 *a* 3 60
4d and 5d, common	3 75 *a* 3 85
3d and 4d, light	4 50 *a* 4 60
3d, fine	5 25 *a* 5 35
2d, fine	5 25 *a* 5 35
Cut spikes, all sizes	3 25 *a* 3 35
Clinch nails, 1½ to 1¾ inch	5 25 *a* 5 65
do. 2 to 2¼ inch	5 00 *a* 5 35
do. 2½ to 2¾ inch	4 75 *a* 4 85
do. 3 inch and longer	4 50 *a* 4 60

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	6 75 *a* 7 00
*I. C. coke, 10x14	5 00 *a* 6 00
*I. X. charcoal, 10x14	8 75 *a* 9 00
*I. C. charcoal, 14x20	5 00 *a* 6 00
*I. X. charcoal, 14x20	8 75 *a* 9 00
*I. C. coke, 14x20	5 00 *a* 5 75
*I. C. coke, terne, 14x20	5 50 *a* 5 75
*I. C. charcoal, terne, 14x20	6 00 *a* 6 25

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb.	— 7¼ *a* — 7½
Sheet, (open)	— 7⅝ *a* — 7⅞

SOLDERS.

No. 1	— 12½ *a* — 13
No. 2	— 11 *a* — 12

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 *a* 1 00
Berlin Freestone, in rough	— 75 *a* 1 00
Berea Freestone, in rough	— 75 *a* 1 00
Brown-Stone, Portland, Conn	1 30 *a* 1 35
Brown Stone, Belleville, N. J	1 00 *a* 1 35
Granite, rough	— 60 *a* 1 25
Canaan Marble	1 25 *a* 1 50
Dorchester, N.B., Stone, rough, per foot	— — *a* 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 *a* 7 25
Chalk, per 100 lbs	— 35 *a* — —
China Clay, per ton gold	18 00 *a* 20 00
Chrome yellow, dry, per pound	— 12½ *a* — 28
Lead, red American, per pound	— 8 *a* — 9
Lead, white American, pure, in oil	— 8½ *a* — 9
Lead, white American, pure, dry	— 7¾ *a* — 8¼
Lead, white English, pure, in oil gold	— 9½ *a* — 10½
Litharge	— 7½ *a* — 8
*Ochre, Fr., dry, per 100 lbs	1 50 *a* — —
Ochre, ground, in oil, per lb	— 6 *a* — 15
Ochre, Vermont, per 100 lbs	— 75 *a* 1 00
*Orange Mineral, English gold	— 9½ *a* — 10
Paris White, American	— 1½ *a* — 1¾
Paris White, English, prime	— 2 *a* — 2¼
Paris Green	— 15 *a* — 28
Plumbago paint, patent, per lb	— — *a* — 25
Putty, per lb	— 2½ *a* — 3
Spanish Brown, dry, per lb	— 1⅛ *a* — 1¼
Spanish Brown, ground in oil, per lb	— 8 *a* — 9
Venetian red, per cwt	1 75 *a* 2 00
*Vermilion, Chinese, per lb	— 85 *a* — 90
*Vermilion, Trieste	— 70 *a* — 75
*Vermilion, quicksilver, bags gold	— 60 *a* — 62½
Vermilion, American, common	— 15 *a* — 18
Whiting, per 100 lbs	— 60 *a* — 80
Zinc, white American, dry, No. 1	— 5 *a* — 7½
Zinc, white American, No. 1, in oil	— 8 *a* — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¼ *a* — 9
Zinc, white French, in oil gold	— 10 *a* — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 *a* 4 00
Coach Body	2 35 *a* 3 50
do do	1 80 *a* 2 00
Furniture	1 25 *a* 2 50
Black Asphaltum	1 00 *a* 1 50
Brown Japan	1 00 *a* 1 20
Liquid Paint Dryer	1 35 *a* 1 75
Harness, (black)	3 00 *a* 4 50
Shellac, Spirits	3 00 *a* 3 50

CEMENT—PER BARREL.

Portland (imported)	2 60 *a* 2 85
Portland (American)	2 50 *a* 2 75
Portland (Spanish)	2 50 *a* 2 75
Portland (Lafarge)	3 20 *a* 3 40
Portland (German, Bonner)	2 85 *a* 3 25
Lime of Teil	2 20 *a* 2 30
Lime of Teil, per ton	15 00 *a* 18 00
Roman	2 75 *a* 3 25
Keene's & Martin's, coarse	6 00 *a* 6 50
" fine	10 50 *a* — —
Rosendale	— 80 *a* — 85

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb.	— 1¼ *a* — 1½

HAIR.

Cattle, per bushel of 7 lbs.	— 16 *a* — 18
Goat, " "	— 21 *a* — 25

SLATE.

Purple roofing slate, per square	$6 00 *a* 6 50
Green slate	7 00 *a* 7 50
Red slate	10 50 *a* 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 *a* 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 *a* — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50 *a* 4 00
Nova Scotia, blue	3 50 *a* 3 75
Calcined, Eastern and city, per bbl	1 25 *a* — —
Calcined, city casting	1 50 *a* — —
Calcined, city superfine	1 75 *a* — —

LIME—PER BARREL.

State, common	— 70 *a* — —
" finishing	— 90 *a* 1 05
Rockland, common, cargo rate	— 90 *a* — —
" finishing	1 00 *a* — —
Ground	— 80 *a* — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 *a* — 20
St. Domingo, crotches, fine	— 20 *a* — 30
St. Domingo, logs, small	— 5 *a* — 8
St. Domingo, logs, large	— 8½ *a* — 14
Frontera, Mexican, large	— 9 *a* — 12½
Frontera, Mexican, small	— 6 *a* — 8
Other Mexican	— 6 *a* — 12½
Honduras	— 6 *a* — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ *a* — 6
Rio Janeiro, good to fine	— 5 *a* — 8
Bahia, ordinary to good	— 2½ *a* — 4½
Bahia, good to fine	— 5 *a* — 8
Honduras, per ton	10 00 *a* 20 00
Satin Wood, per foot	— 15 *a* — 25
Tulipwood, per lb	— 6 *a* — 7
Lignumvitæ, large, per ton	25 00 *a* 50 00
Lignumvitæ, other sizes	10 00 *a* 20 00

CEDAR.

Cuba, per superficial foot	— 8 *a* — 11
Mexican, small	— 8 *a* — 9½
Mexican, large	— 10 *a* — 11
Florida	— 40 *a* — 75

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,		$0 70
3 "	0 16	12 "		0 80
4 "	0 20	15 "		1 25
5 "	0 25	18 "		1 60
6 "	0 30	20 "		2 00
7 "	0 35	22 "		2 50
8 "	0 45	24 "		3 00
9 "	0 55			

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¼ inch.	$ 84	——
2.6 x 6.6	1¼	1 18	——
2.6 x 6.8	1¼	1 24	——
2.8 x 6.8	1¼	1 30	——

DOORS, MOLDED.

Size.	1¼ inches.	1⅛ inches.	1¾ inches.
2.0 x 6.0	$1 54	——	——
2.6 x 6.6	1 90	2 41	——
2.6 x 6.8	1 96	2 43	——
2.6 x 6.10	1 98	2 51	——
2.6 x 7.0	2 02	2 61	——
2.8 x 6.8	2 02	2 61	3 25
2.8 x 7.0	2 11	2 71	3 35
2.10 x 6.10	2 23	2 82	3 50
3.0 x 7.0	2 33	3 06	3 75

REVIEW OF THE MARKETS.—In the lumber market the past month, some few points of improvement have been shown, but have been confined to one or two grades, and, as a whole, the market has been dull. Consumers who are under engagement for fall work, which will require special cuts, etc., appear to be convinced that nothing can be gained on price by holding off, and they have, therefore, entered into contract for a portion of their supplies, especially such as may be drawn from the Eastward. The feeling, however, is not sufficiently general to create liberal demand or much excitement. Accumulations here have been growing a trifle, but there are no dealers who appear to have had a surplus of stock of attractive quality.

In the brick market there has really nothing occurred of interest on the general market, business moving along quietly, and values keeping down to about a basis of former figures. The balance between supply and demand has shown a slight surplus of the former, and this has naturally neutralized any effort to secure an advance on price. Sellers, however, have not been inclined to make any special effort toward buoyancy, being content to keep cargoes moving at the return to be secured rather than take action calculated to injure trade in any way. Makers have been talking about stopping work, but no time has been fixed, or even suggested. Front brick have been in about proportionate demand, and remained steady on all the principal makes.

In the lime market demand has been good, and exhausted everything available as well as the bulk of the stock to arrive. Indeed, there has been a very strong market all around, and the full figures of the late advance have been maintained on both Eastern and State stock.

In the lath market we have heard of two or three cargo sales since our last, and all at $1.50 per M, which seems to have become a fixed rate. Receivers, however, have been claiming that it cannot remain fixed long, on the theory that the wants of dealers are gradually but surely increasing, and that this must soon be reflected upon the wholesale market. Eastern advices, too, have been strong, and having succeeded in securing an advance on lumber, manufacturers will be more inclined than ever to use efforts to increase the cost of lath.

In the hardware market the movement of supplies has been of somewhat irregular character, and the manner in which invoices have been made up, has demonstrated that buyers have by no means departed from the caution which has long governed demand. Business, however, is unquestionably on the increase, and all present indications are favorable for a good fall trade.

In the metal markets domestic pig iron has sold with moderation, and few buyers could be induced to take supplies to an extent exceeding early and well-known requirements. There has been a moderate and rather diminishing offering of desirable stock, however, and on all the leading brands cost has been advanced. Scotch pig has been strong at advancing rates. Domestic pig lead has sold with a little greater freedom, but the supply available for the outlet was ample, and no great advance in price secured. Tin in pig has found a good demand, and with the stocks under control holders have been firm at higher rates. Tin plates have sold rather freely, and values have ruled firm.

In the paint market distribution has been slow and without many really encouraging features. Dealers, however, are hopeful of a good fall trade.

The Adhesion of Belts.

J. H. Cooper, a well-known writer, has the following in the Boston *Journal of Commerce:*

"The driving power of belts—by which we mean the holding on to, the adhesion, or that which imparts motion to a belt while in contact with a revolving pulley—has been attributed to several causes, to one of which I wish to refer—that of atmospheric pressure. It is called to mind now by reading some articles in late issues of your paper, which lay great stress upon the efficacy of this means of creating adhesion. This announcement is much like that startling physiological statement of the many tons of pressure imposed upon the human body by the atmosphere, which is very taking to the sense until better known.

"A belt has a movement to and from a pulley with perfect freedom, regardless of the atmosphere, *touching* it as its form, pliability and strain permit, and *holding* to it according to the interposed unguent, adhesive, or what not, which has been spread over the surface of the belt and pulley. The kind of adhesive used has much to do with the driving power of belts. Suppose fine lubricating oil be employed on clean surfaces of belt and pulley; this will effectually exclude the air from the surface of contact, but the driving power will be reduced to a minimum, if there be any at all transmitted. If dry dust of yielding material be employed on clean surfaces of belt and pulley, then indeed will the air, with the dust, diminish driving power. There are conditions of belt driving where it is alleged the interposed film of air *lessens* adhesion. Upon this, Rankin says: 'It is well known, through practical experience, that a belt for communicating motion between two pulleys, requires a greater tension to prevent it from slipping when it runs at a high than at a low speed. Various suppositions have been made to account for this, such as that of the adhesion to the belt of a layer of air, which, at a very high speed, has not time to escape from between the belt and the pulley. But the real cause is simply the centrifugal force of the belt, which acts against its tension, and therefore slackens its grip on the pulleys.'

"In collecting 'belting facts and figures,' during the last score of years, for my own use, I met with several statements asserting with considerable confidence the doctrine of 'suction' as the chief cause of attachment between pulley and belt; but I could not find anywhere written a fair statement of reasons why such force did not act according to the circumstances of belt driving, nor could I discover any appeal to experiment, which, by removing the atmosphere, in this case putting suction outside the apparatus, and thus settling once for all the value of vacuum for belt driving.

"It is very true, that if the belt does not touch the pulley, it cannot pull it around, nor can it be driven by the pulley. It is also true, that if belt and pulley touch on a limited area only, each can drive the other with a force but a part of what it is capable of doing, and it is only when contact is made perfect—that is, when every square inch of the belt, so to speak, is down solid on the pulley surface, which surface we will grant is very smooth—that the greatest driving effect is obtained. These things being so, are we yet warranted in concluding that the imparting of motion from belt to pulley, and pulley to belt, is all the work of the air, or rather the effect of its absence from the region of contact, and the presence of it on opposite sides of belt and pulley?

"Again, is the driving of the belt in the same direction as that in which the suction is felt? Now, mark, the atmospheric resistance becomes sensible by pulling at *right angles to a plane surface of joint which does not admit air.* Release the pull, and try to slip the *sucker* over the surface to which it is applied; it moves freely in every direction, offering no resistance, possessing no adhesion, being in fact in equilibrium, and, by lifting one edge, can be raised wholly away with ease. The power of the belt does not move in lines at right angles to its contact with the pulley face, but tangent to the pulley circle—parallel to the face of contact. As we slip the *sucker* freely on the flat wetted surface, so the belt slides on the pulley face; there is no atmospheric pressure manifest in either case.

"But has any one tested this matter in a vacuum, and made record of the results gained? I have; and, if you allow me, will quote, from 'Use of Belting,' what I said about this several years ago: 'The adhesion of belts to pulleys is frequently attributed to the pressure of the atmosphere; and, in order to show how much the air influences belts in this particular, the following simple experiments are presented: Take circular disks of leather, say three or four inches in diameter, with a knotted string secured in its center, and, when well water-soaked, press it upon any level wetted surface. The boys call this apparatus a "sucker," and it well illustrates the phenomenon of atmospheric pressure, or "suction," as it is usually called. If an effort be made to draw it away from this surface by the string, it will be found resisting very forcibly, but the gentlest pressure will slide it on the wetted surface. It does not offer the slightest opposition to motion in the direction of its face, nor will it resist removal if raised first at the edge and then peeled off. The atmosphere does not press two bodies together when it can get between them. It is only when excluded by a tight joint that the development of its pressure is possible; and it becomes sensible only when an effort is made to separate them by a force acting at right angles to the plane of their faces. Another simple experiment shows that when two level, smooth and clean surfaces come together, by a motion like the closing of a book—which is similar to that of a belt coming in contact with its pulley—there will be retained, between the two, a thin film of air; and while this remains, the contact of the two is imperfect, and the sliding of one over the other is easily performed. Take two iron "surface-plates" which have been scraped down to a practically perfect plane and lay one of these on the other like a belt goes to a pulley. They will be found not in contact at all, but as if floating one on the other, and the top one will slide off by its own weight at the least inclination of the lower one. Much of this interposed film of air can be displaced by a sliding of one plate on the other, starting, say at one corner, with the plates in close contact, and carefully pushing one over the other, holding it the while close to, as if to keep the air out. Then, indeed, an obstinate resistance to sliding will be felt, and the friction of nearer contact will be made thoroughly sensible. But this way of bringing surfaces into contact has nothing to do with belt action, except to prove the need of plastic surface on belt and pulley, which will enable them to adhere, while in contact, with sufficient force to prevent sliding, and at the same time be uninfluenced by the intermedium of air. And, lastly, in order to put the matter to actual test, an apparatus was constructed, such that a leather belt was made to slide on the face of a smooth iron pulley, and also to drive the same iron pulley up to slipping of the belt. In both cases, the adhesion or driving power of the belt was held by a spring balance, so the work of the belt could be observed. Experiments were tried with this mechanism placed in a bell glass jar on an air-pump plate, with and without air in the jar, and if any difference was observed in the adhesion of the belt to the pulley, it had more in vacuum than when the atmosphere was present.'"

Is It So?—A foreign scientific journal remarks, as a curious physiological fact, that although open-air life is so favorable to health, yet it has the apparent effect of stunting the growth in early youth. Thus, while the children of well-to-do parents, carefully housed and tended, are found to be taller for their age than the children of the poor, they are not so strong in after years; the laborer's children, for instance, who play in the lonely country roads and fields all day, whose parents lock their humble doors when leaving for work in the morning, so that their offspring shall not gain entrance and do mischief, are almost invariably short for their age; the children of working farmers exhibit the same peculiarity. After sixteen or eighteen—after years of hesitation, as it were, the lads shoot up, and become great hulking, broad fellows, possessed of immense strength. According to these statements, it would seem that in-door life forces growth at the wrong period, and thus injures. Is it so?

The Estimation of Carbon in Steel.

Mr. James W. Westmoreland, A.R.S.M., of the Bowling Iron Works, Bradford, England, writing to the *Chemical News*, says that M. Sergius Kern impugns the accuracy of the color test for the estimation of combined carbon in steel, and Mr. W. D. Hermann, in advocating the direct combustion process, states the general opinion of chemists that the color test is not accurate. Mr. Westmoreland continues:

"The objections to the direct combustion process, are, that the steel is required in a fine state of division, and the uncertainty as to the completeness of the reaction, while the time required by any combustion process would prevent its regular use in steel works, where it is not unusual to test from thirty to fifty samples daily. Having used the color test extensively for some years, I find that in most cases the results obtained by it agree well with those obtained by other processes—that concordant results are obtained by analysts working independently on the same sample, and that discrepancies which arise are due more to errors or inexperience than to any defect in the method. In order to compare the processes, I was requested to examine by color test a series of samples of steel in which the carbon had been estimated by combustion (between 60 and 70 samples were examined), the greater number of the experiments being made in the year 1876, with others at intervals up to the present time. The following are examples of the result obtained in 1876:

Carbon per cent.

	A	B	C
1	0.285	0.280	0.30
2	0.349	0.340	0.36
3	0.158	0.152	0.18
4	0.565	0.532	0.48
5	0.147	0.122	0.16

"The results in column A were obtained by combustion, the steel being dissolved in a solution of chloride of copper, etc., the separated carbon being finally burnt with oxide of copper in a stream of oxygen gas. This process, although tedious, is very accurate. The results in column B were obtained by myself, using the color test, in the Bowling laboratory. The results in column C were obtained by the color test in the laboratory of the South Wales steel works. The following experiments were made in May, 1878:

Carbon per cent.

	Combustion.	Color Test.
6	0.355	0.35
7	0.515	0.50
8	0.189	0.19
9	0.29	0.27
10	0.415 0.41	0.42
11	0.05	under 0.10
12	0.622	0.67 0.647

"The combustions were made as before, and the color estimates by myself, then engaged as chemist to the Rhymney Iron and Steel Company. The sample No. 11 shows one of the defects of the color test—that it cannot be used for estimating very low percentages of carbon in steel, and, on the other hand its indications with high percentages are not very exact. For steel works' purposes, however, where estimations, ranging from 0.10 to 1.00 per cent combined carbon, are required in large numbers, and quickly, it is invaluable, taking but little time, and giving results agreeing well with those obtained by other methods."

Preserving Leather.—To preserve leather hose, belting, etc., in good condition, use crude castor oil, warmed if possible, and freely applied. It increases the pliability of the leather and the cling of the belts, and does not become rancid. Rats avoid it. In hose it should be pumped in from the interior under considerable pressure, thus thoroughly filling the pores.

Home Department.

Necessity of Proper Mental Employment and Relaxation.

Not a few persons who abandon their employments under the impression that they will be happy in doing so, actually die of ennui. It induces bodily disease more than physical or mental labor. Others, indeed, survive the ordeal. But, where the body does not suffer, the mind often does. We have known instances of persons whose habits have been suddenly changed

Fig. 1.—Dining Chair.

from those of great activity to those of no employment at all, who have been for a time in a state of mental excitement or hypochondriasis, bordering on mental aberration. Moreover, it is with the mind as it is with the body—it is spoiled from want of use; and the clever and intelligent young man who sits down to lead what is called a life of leisure, invariably becomes a stupid old man.

A man in a profession may be engaged in professional matters for twelve or fourteen hours daily, and suffer no very great inconvenience beyond that which may be traced to bodily fatigue. The greater part of what he has to do (at least it is so after a certain amount of experience) is nearly the same as that which he has done many times before, and becomes almost matter of course. He uses not only his previous knowledge of facts or his simple experience, but his previous thoughts, and the conclusions at which he had arrived formerly; and it is only at intervals that he is called upon to make any considerable mental exertion. But at every step in the composition of his philosophical works, Lord Bacon had to think; and no one can be engaged in that which requires a sustained effort of thought for more than a very limited portion of the twenty-four hours. Such an amount of that kind of occupation must have been quite sufficient even for so powerful a mind as that of Lord Bacon. Mental relaxation after severe mental exertion is not less agreeable than bodily repose after bodily labor. A few hours of *bona fide* mental labor will exhaust the craving for active employment, and will leave the mind in a state in which the subsequent leisure (which is not necessarily mere idleness) will be as agreeable as it would have been irksome and painful otherwise.

Man and his Food.—Of course, various conditions of life, climate and locality, have to do with the quantity of food. Thus, an idle person can get along very well with two and three quarter ounces of nitrogenous food and twenty ounces of carbonaceous food (flesh and cereal or vegetable food), when, if the same individual were walking or in active out-door life, double this quantity might be used. Perhaps the Esquimaux represent the heaviest feeders in the world, for Parry tells of a young native who devoured in the twenty-four hours 9½ pounds of sea-horse—half raw, half cooked, 1¾ pounds of ship-bread, 1¼ pints of water, not counting grog and spirits. Both Sir John Ross and Dr. Hayes, from personal observations, declare that the daily ration of an Esquimaux may range from 12 to 20 pounds of flesh food. On the other hand, it is quite remarkable how small a quantity of food a man may eat and still retain his health, though, as to the point of mental vigor engendered by scanty fare, that is another question. Cornaro, who wrote a treatise on long life, subsisted for 58 years on 12 ounces of vegetable matter and 14 ounces of wine per diem, while another case is cited of a man existing for not quite 20 years on 16 ounces of flour per diem, made into some kind of pudding.

Perforated Veneer for Chairs, Seats, etc.

We give on this page three figures illustrating tasteful designs of chairs and seats made by Messrs. Gardner & Co., of 183 Canal street, this city, of whose products we have previously had occasion to make favorable mention. The backs and seats of these goods, as will be observed, are covered with a perforated veneer, which, while giving all the lightness and coolness of a cane or ratan covering, gives them decidedly greater durability in service. The strength of the covering is insured by employing three thicknesses of veneer, the fibers of the center layer laid at right angles to the others, and the whole glued together. By this disposition, warping is provided against. The perforations are made to subserve the purpose of decoration, by arranging them according to various tasteful designs. The perforations thus serve the double purpose of ventilation and decoration.

The plain and arm chairs (Figs. 1 and 2) need no special description. The "opera settee" (Fig. 3) is a novelty which deserves wide popularity. It is beautiful in appearance, comfortable in use, and has the advantage that it can readily be removed from the hall or room should the space be required for other purposes.

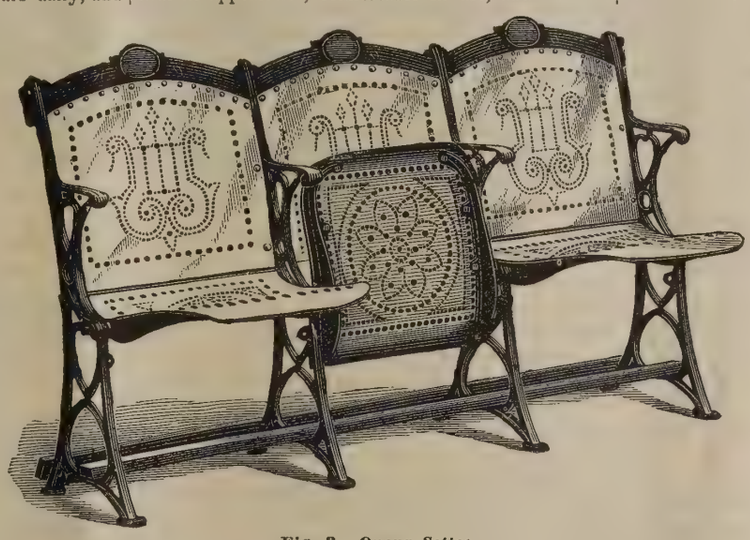


Fig. 3.—Opera Settee.

Window Gardens.

In the cultivation of plants outside the window, boxes should invariably be employed, apart from all considerations as to their appearance, because of the protection they afford the roots from extremes of temperature. When the pots are placed upon the sill without any protection, as is frequently done, it is a matter of extreme difficulty to maintain the plants in a healthy state, for not only are the roots subjected to an injuriously high temperature during periods of bright weather, by the action of the sun upon the outside of the pots, but the moisture is so quickly evaporated from the soil forming the sides of the ball, that it is practically impossible to prevent their suffering more or less from drought. The least troublesome, and as a rule the most satisfactory, way of embellishing windows, is to grow the plants entirely in the boxes; but if it is so desired, they may be grown in pots, and be then plunged within the boxes in cocoa-nut fiber refuse. This latter plan entails considerable labor, but

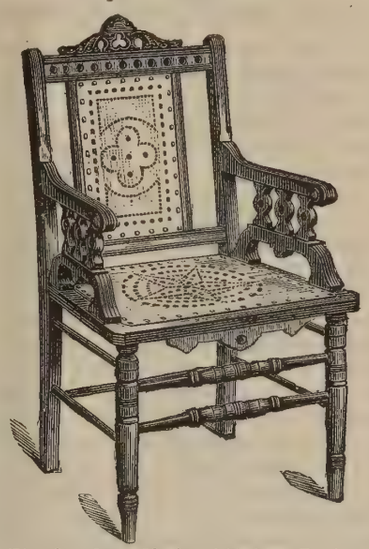


Fig. 2.—Arm-Chair of Unique Design.

it has the great advantage of affording facilities for changes to be made when thought desirable; and in some instances this would more than counterbalance the additional labor entailed. The form of the boxes, and the material of which they are made, must in a great measure be determined by the style of architecture of the house, and the taste and means of the occupant. For cottages and small villas, boxes of rustic wood and of deal, with a neat molding along the bottom and the upper edge, and painted dark green, brown, or chocolate, are the most suitable, while for more pretentious structures, boxes faced with tiles are preferable. In the selection of tile boxes, those rather quiet in coloring should have the preference, as they show off the flowers and foliage with which they are furnished to much greater advantage than those of which the tiles are very brightly colored. In all cases they must fit the windows nicely, and they must be of sufficient width and breadth to hold a goodly quantity of soil, or the plants will not be much better off than they would be in pots. The boxes ought, as a rule, to be not less than 9 inches in width and depth, and if they project a few inches beyond the sill, it will not be a matter of much consequence, as their appearance will not be at all objectionable, and they can be held securely in position by neat brackets, one at each end.

Treatment of Sunstroke.

In case of sunstroke, loosen the patients clothes and bathe the head and entire body with cool water, and with moistened hands rub the extremities, the neck, and the whole length of the spine, rubbing in a downward direction to draw the blood from the head. As soon as boiling water can be obtained, put a dry blanket round the body, then wring flannels from the hot water and apply them quickly to the region of the stomach, liver, bowels and spine, over the blanket; also immerse the feet in hot water, or wrap them in

hot flannels as far as the body. Re-wring the flannels once every five or eight minutes for half an hour or more, then remove them and apply cold water in the same way, either by cool towels or sponging with cool water; dry well and rub the surface lightly and briskly with the hand until a glow is produced. As soon as the patient can swallow, give him hot water to drink, and plenty of it, with occasional bits of ice or sips of cold water. Often, of course, the attack is so slight that so thorough treatment is not necessary.

The 49th American Institute Exhibition.

As our readers are informed by announcement in our advertising columns, the forty-ninth annual exhibition of the American Institute will open on September 15th, and intending exhibitors will be able to obtain full information respecting details by addressing the General Superintendent.

We trust that our leading manufacturers, and especially those in our immediate vicinity, will be fully represented at the exhibition this year, that it may be what all the friends of the Institute earnestly desire to have it—a representative exposition of American progress in the arts and manufactures. From the important commercial and manufacturing position of New York, this is what it should be made, and nothing but proper effort will be required to enlist the warm cooperation of our best machine builders and manufacturers to place the exhibition beyond the reach of rivalry. This journal has had occasion in the past to criticise the character of the annual exhibitions of this Institute, but these criticisms have been made in a friendly spirit, and were directed to those points wherein the efforts of those having the management of the enterprise had been obviously lacking in result. Our criticism was especially directed to the lack of representative exhibits in the machinery department, and in this respect we look forward this year to see a decided improvement.

One feature which the managers have introduced this year, is worthy of special commendation. They have decided to invite an exhibition of the work of amateurs and apprentices in all branches of mechanical, industrial and decorative arts. This is a move in the right direction. It is this class that will most fully appreciate the encouragement that the Institute holds out to them, and that will derive the most benefit from it. The exhibits in this class will be admitted free of charge, and will be distinguished by the award of premiums to the most deserving. A Committee of ladies proficient in the estimation of the merits of artistic work will be added to the list of judges, to pass upon such exhibits as are embraced in this department, which will include sculpture, painting, embroidery, decorated china, wood-carving, and other artistic handiwork.

We look forward to the coming exhibition with pleasant anticipations, and hope that the managers and our manufacturers will join hands to make this year's display a credit to the Institute, and to the city in which it is to be held.

Coffee Production.

In our July issue some figures were published in relation to the coffee production of the world and the proportion used by the various nations. Curiously enough, our own country, one of the largest consumers, was omitted, an omission we hasten to supply by stating that the United States uses 8¼ pounds per head per annum, coming after Norway, which consumes 8½ pounds per head per annum.

We have some later statistics, which give the annual yields of the principal coffee-growing countries. These figures are based on the product for the year 1878: Brazil, 496,100,000 lbs.; the Dutch Indies, 201,090,560 lbs.; Ceylon and British India, 117,529,280 lbs.; West Indies, 91,960,000 lbs.; South Africa, 79,178,000 lbs.; Central America, 71,500,000 lbs.; West Africa, 8,800,000 lbs.; the Philippines, 7,472,960 lbs.; Arabia, 6,114,200 lbs.; South Sea Islands, 330,000 lbs. The total product for the year named was 1,080,075,000 lbs., and not 1,080,975,000, as printed in our last issue.

Miscellaneous and Advertising.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

We note with pleasure a steady increase in orders which the New York Safety Steam Power Co., of 30 Cortlandt street, this city, are receiving for their admirable engines—a success which is well deserved, as these engines are models of perfection. The fact that over 800 are in use, and giving the best satisfaction, is sufficient evidence of merit.

We call special attention to the advertisement of S. C. Forsaith & Co., of Manchester, N. H., in another column, in which they offer 1,977 machines for sale, both new and second-hand. Machine-shop owners and parties about fitting up manufacturing establishments, should send to this firm for their list No. 23, in which the above-mentioned machines are described.

The Otis elevator is so well known that it would be superfluous to call attention to it, otherwise than to note the fact that Otis Brothers & Co., the manufacturers, are constantly making improvements and acquiring new patents, toward the "better perfection," if such a phrase is allowable, of this modern and indispensable convenience. The office of the firm in this city is at 346 Broadway.

One of the largest, if not the largest, establishments in the country engaged in the manufacture of drain and sewer pipes, is the Akron Sewer Pipe Co., of Akron, Ohio, whose products have been illustrated in these columns. Owing to the immense facilities possessed by this company, they are enabled to execute the largest orders in the shortest possible time. The great superiority of their pipe over other brands sold in the market, is generally acknowledged by contractors and builders of experience who employ it, and if further testimony were needed, the enormous annual sales of this product would complete the evidence in its favor.

We would particularly invite the attention of architects and builders to the patent packing and gate and globe valves manufactured by Jenkins Brothers, 104 Sudbury street, Boston. The packing is a special composition of rubber, with talc, graphite and other refractory substances, which speedily becomes so changed under the action of heat and pressure, as to acquire extreme hardness and durability to resist their destructive action. The "gate," "globe" and pump valves have likewise specially meritorious features. The goods manufactured by this firm are of excellent quality for their intended uses, and have the additional merit of being cheap, two qualifications which have secured for them a constantly increasing sale.

The Increasing Use of Steel Castings.—The rapid substitution of steel castings for expensive forgings and for iron castings, where great strength is required, has compelled the doubling of the capacity of the works of the Chester Steel Castings Company during the past year; and now the company announce a still further extension of their establishment. Their chief success, as well as the heaviest part of their business, is in the production of heavy gear wheels, pinions, roll spindles, couplings, coupling boxes, etc., for rolling mills and sugar mills. In heavy plate mills their steel castings outlast many times the iron castings formerly used. It is claimed also that nearly all the locomotive builders and makers of large steam engines are now using the Chester castings, and that the fifteen thousand crank-shafts and several thousand cross-heads on locomotives, of their make, show a better record for durability and smoothness of wear, than any equal number of forged pieces for the same uses.—*Scientific American, July 17th.*

It gives us pleasure to announce that the Clayton Steam Pump Works, of Brooklyn, N. Y., have obtained the contract for the balance of air compressors required by the Hudson River Tunnel Company. The following report of Mr. C. W. Clift, the Chief Engineer, respecting the working of these compressors is of interest:

Jersey City, N. J., July 12th, 1880.

James Clayton, Esq., Proprietor Clayton Steam Pump and Air Compressor Works, Brooklyn, N. Y.

Dear Sir: Referring to the air compressor of your make, furnished the Hudson River Tunnel Company in December last, we are pleased to say that it has done its work admirably, maintained an even, steady pressure of air in the air-lock, and has for over a month past been working night and day without one moment's cessation. In fact, it has afforded us the very best satisfaction, and we take great pleasure in recommending it, and hope that the large duplex air compressors which you now have under construction for us, will be equally successful. Yours truly, Chas. W. Clift,

Chief Engineer in Charge of Machinery of the Hudson Tunnel Railroad Co.

Design for Swiss Cottage, Costing $3,000.

by D. T. Atwood, Architect.

The design on the opposite page exhibits the construction combining or uniting wood and brick, and known as "brick nogging," and affords agreeable contrasts in this style of architecture, as well as in the Elizabethan, Jacobean, James I. epochs, and some other styles, and is always a substantial and handsome way of building.

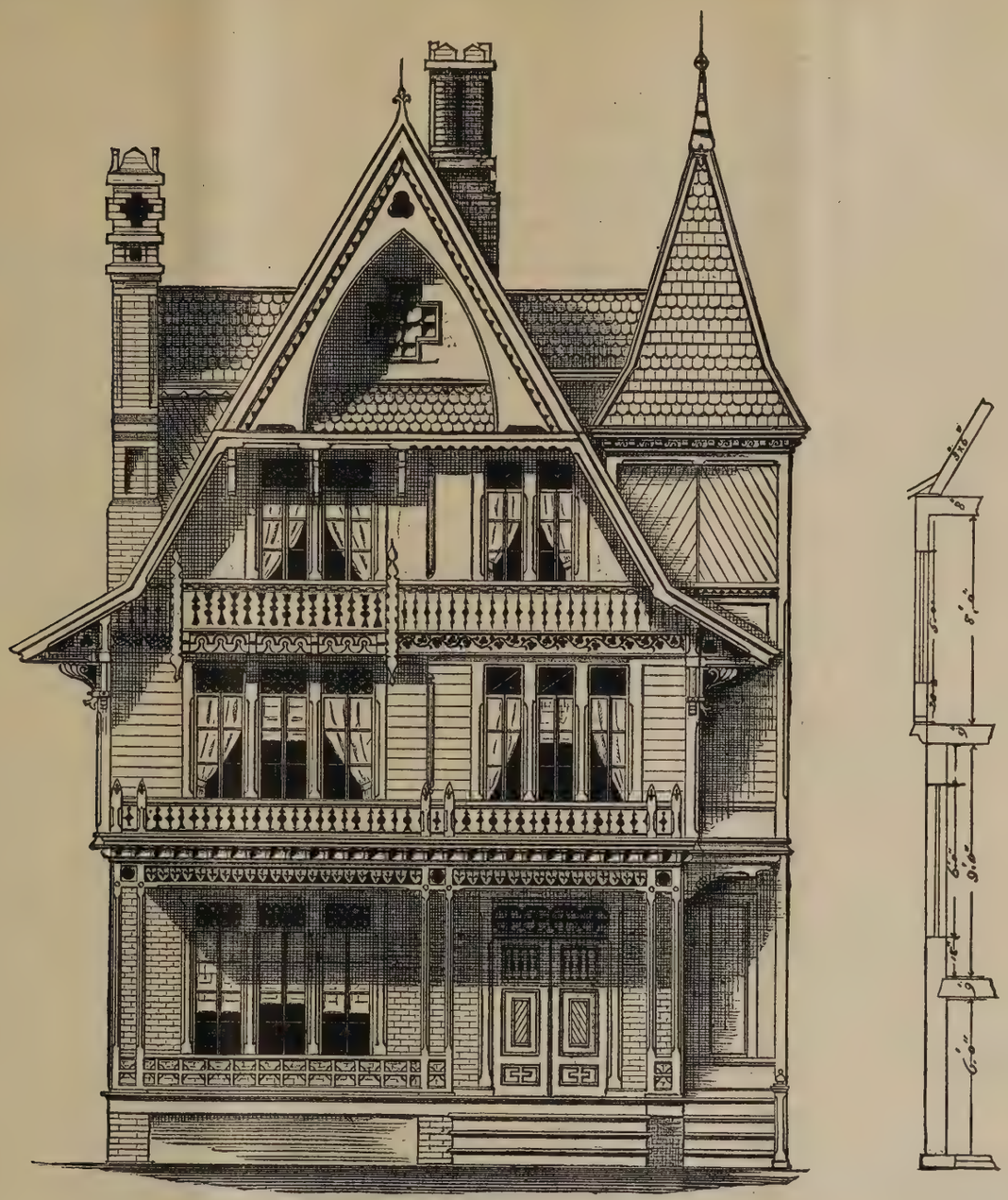
The character of the exterior details and the interior finish correspond, and the former are shown with sufficient clearness in the elevation to require no explanation. The arrangement of the interior is worthy of special attention, being most convenient in every part; on the first floor there is a parlor, 12 × 12 feet, and back of this a dining-room of the same size, and in the rear of the latter, extending out into a bay-window, is a sewing-room. The kitchen is 12 × 12 feet. On the second floor there are four bedrooms of the following respective dimensions: 12 × 12 feet, 9 inches; 8 × 12 feet, 9 inches; 8 × 12 feet, 9 inches; 7 × 8 feet, 9 inches. There is also a bath-room and water-closet on this floor, 7 × 8 feet. Each room is provided with ample closets, a feature that will be appreciated by housekeepers. The third story has five rooms of similar size.

The walls of the first story are built hollow, and receive the plaster directly upon the brick. The door and window trimmings are 4½ and 5 inches, framed and put up in pilaster form. The hall and dining-room are wainscoted with redwood and yellow pine in alternate sections and panels. The staircase in the lower hall is also built of these woods. The parlor is finished white, with china gloss and gold bands; the hall in gray and brown. The upper rooms are finished in neutral tints of varying shades of color. All mantel breasts are exposed, and faced with pressed and molded bricks of various and suitable tints, suited to the furnishings of the rooms, and provided with marble and slate shelves. The openings are segment and semi-circular, headed with spandrels and arches set with art tiles.

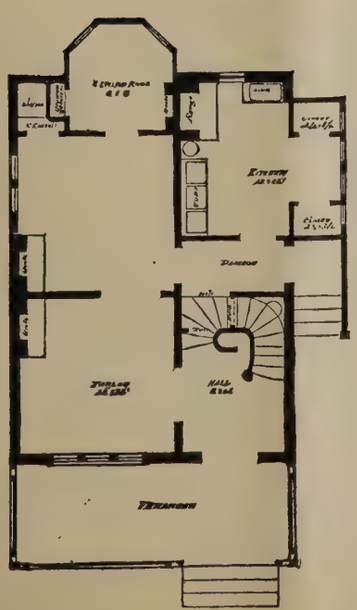
The rooms are separately ventilated, and, except in the parlor and dining-room, the furnace heat is supplied through the front openings. Patent radiating backs and low grates are supplied to the parlor, dining-room, and sewing-room; fire-places, with ash shutes, to the cellar.

The exterior is painted bronze gray and umber colors.

This house is estimated to cost, in the vicinity of New York city, $3,000. The architect is Mr. D. T. Atwood, of 335 Broadway, New York.

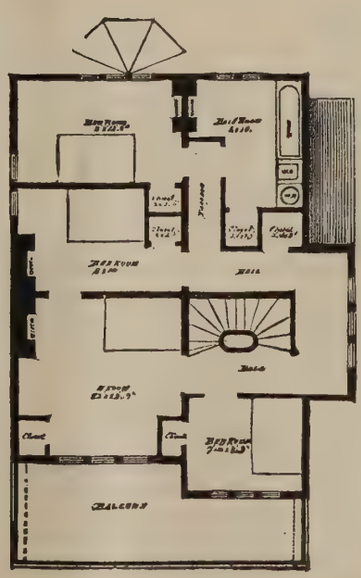


FRONT ELEVATION.



First-Story Plan.

DESIGN FOR SWISS COTTAGE,
COSTING $3,000.



Second-Story Plan.

The Preservation of Timber.

It has long been a matter for regret among our engineers, that the subject of the preservation of timber has been so generally ignored by railway men and others, who, from the nature of their positions, might be presumed to be thoroughly familiar with it, and fully alive to its importance as a commercial factor affecting their business interests. Numerous experiments in timber preservation have been made in this country during the past twenty-five years, but thus far no systematic effort has been put forth to collect the results that have been obtained, and which would furnish the profession with a valuable body of facts, from which reliable inferences might be drawn concerning the best modes of procedure for future guidance. As the methods and materials for impregnation vary very greatly, the elaborate details of foreign experience which are available, are only of general value. What is wanted, is a careful compilation of American experiments in timber preservation, with the fullest regard for the details of kind and quantity of impregnating materials, method of impregnation, the conditions, time of exposure, and others of equal importance. The time is not very distant, when, from the growing scarcity and cost of timber for railway and other constructive uses, the question of its preservation will assume as important a position in this country as it has long held in Europe. There is a special appropriateness, therefore, in the determination of one of our leading engineering societies to investigate the subject in the manner above indicated.

The circular letter of the American Society of Civil Engineers, which we append hereto, will explain itself, and needs no further comment from us than the statement that we trust it may receive generous responses from all of our engineer readers who have any facts bearing on this subject:

To Engineers, Architects, Preservers of Wood, Chemists, and others:

The undersigned, a Committee of the American Society of Civil Engineers, appointed to report upon the preservation of timber, earnestly solicit information concerning past experience in the impregnation and preservation of that material. Particulars of failures in this country, and, if possible, the reasons therefor, are especially desired. Also information on the following points in each of the processes which may have been used:

1st. Kind of timber operated on—green or dry—age, dimensions, etc.

2d. Preserving ingredients injected.

3d. Quantity injected per cubic foot or tie.

4th. Mode of application, process, time employed, degree of heat, pressure, vacuum, etc.

5th. Subsequent use and exposure of timber (bridges, buildings, or track).

6th. Result of preparation, and comparison with life of unprepared timber.

This special and any general information on the subject, is respectfully solicited. Replies can be mailed to the chairman of the committee.

Committee:

B. M. Harrod, Chairman,
122 Common st., New Orleans, La.
G. Bouscaren, 382 W. 3d st., Cincinnati, O.
E. R. Andrews, 10 Warren st., New York City.
E. W. Bowditch, 60 Devonshire st., Boston.
Col. Geo. H. Mendell, U. S. Engineer, San Francisco, Cal.
J. W. Putnam, P. O. Box 2734, New Orleans, La.

The Growth of Large Factories.

No other great industry has ever been concentrated in the hands of large corporations to so great an extent as the cotton manufacturing interest. But the same tendency has been manifest of late years in the iron and woolen and shoe trades, and, in fact, in all other interests. Within the past fifteen years the number of boots and shoes produced in the city of Lynn has increased enormously while the number of manufacturers engaged in the business has diminished. Late statistics report the number of woolen mills in England as 1,732 against 1,829 eight years ago, a decrease of 97. But the number of woolen spindles in operation at the present time is 3,337,607 against 2,531,788 eight years ago.

The increased use of labor-saving machinery has not been the only influence which has led to the concentration of manufacturing and mercantile interests in the hands of fewer and larger concerns. A season of fluctuating values, like that of the past year, always militates against the smaller operators in every branch of trade. The manufacturers and merchants possessed of large capital are the ones who have been able to lay in stocks of material previous to the advance, and who can therefore produce their goods at the lowest cost.

During the past fifteen years, the number of small manufacturers who have given up business on their own account and entered the employment of larger concerns, is legion. The little shoe shops which used to fringe the thoroughfares of Lynn a couple of decades ago, first gave place to factories in which the same tendency to larger growth and greater concentration still continues.

New Publications.

The Civil Engineer's Pocket-Book, of Mensuration, Trigonometry, Surveying, Hydraulics, Hydrostatics, Instruments and their Adjustments, Strength of Materials, Masonry, Principles of Wooden and Iron Roof and Bridge Trusses, Stone Bridges and Culverts, Trestles, Pillars, Suspension Bridges, Dams, Railroads, Turn-Outs, Turning Platforms, Water Stations, Cost of Earthwork, Foundations, Retaining Walls, etc. By John C. Trautwine, Civil Engineer, Philadelphia. Illustrated with 670 engravings from original designs. Fourteenth Thousand. Revised and Corrected. Philadelphia: E. Claxton & Company. London: Trübner & Co. 1881. Price $5.

With the above announcement of the publication of a fourteenth edition of this portable encyclopaedia, we feel as though it were unnecessary to say anything more, for the host of engineers, contractors, builders and machinists who own and use the work, will need no encomiums from us to estimate its value, and no book-notice can do justice to a work which is simply a marvel of patient labor and thoroughness. That the possessors of earlier editions may know that material and important additions have been made to this one, we will state that many new engineering facts are scattered throughout the volume. The publishers note in their announcement that some subjects, such as "Cements and Concretes," "Riveting," etc., have been entirely rewritten; others have been much altered, and those on "Flotation," "Moments of Rupture and Resistance." "Kutter's Formula," "Open and Closed Beams," "The Shearing of Beams," "Test Borings," the valuable experimental results of C. Shaler Smith on "Eye Bars and Pins," etc., are given for the first time, along with many new tables indispensable to engineers, machinists and builders. The improved modern engineer's transit instrument, and the level, as made by Heller & Brightly of Philadelphia, are now figured instead of the old-fashioned ones. Much heavy, black letter has been inserted throughout the volume, and will be found a great relief to the eye, especially when looking for minor items referred to in the index. The index has been entirely renewed, and made much fuller than before.

In proof of the estimation in which the work is held by competent professional authorities, the publishers cite the following: Mr. Alfred P. Boller, C.E., in his "Iron Highway Bridges," says: "For a wonderfully clear and elaborate discussion of force, strains, etc., as well as upon the subject of trusses and strength of materials, free from all technicalities, the learner is referred to Mr. Trautwine's 'Engineer's Pocket-Book,' a work that should be the corner-stone of every engineer's library." Mr. George L. Vose, C.E., Professor of Civil Engineering in Bowdoin College, in his "Civil Engineering," says: "Mr. Trautwine's 'Civil Engineer's Pocket-Book, is, beyond all question, the best practical manual for the engineer that has ever appeared." Mr. Thomas M. Cleemann, C.E., in his "Railroad Engineer's Practice," remarks that he "considers that no other book has appeared which supplies so well a constant want of the engineer, at all stages of his career, as Trautwine's 'Engineer's Pocket-Book.'"

With these endorsements of the excellence of the "Pocket-Book" we heartily concur, and may add, from the result of our own examination of the present edition, that it contains a large amount of new information not specified in the publishers' announcement. Compared with the earlier editions, it might in fact be almost regarded as a new work. For the young engineer, it is in itself a portable library, in which he will find the fundamental principles of his profession elucidated in plain language. We know, in fact, of no other work, the contents and portability of which, adapt it so well to the requirements of an assistant engineer, whether he is out on active service or settled down at home, with leisure for study. Nor are we surprised that our leading contractors have adopted it as a standard book of reference. Its clear style of expression, and its large array of engineering facts, make it invaluable to them also. Among machinists, likewise, its circulation must be extensive, for we rarely enter an establishment of repute but our eye falls upon it, either in the book-case or on the office table.

By employing small type, the publishers have been enabled to condense into this one pocket volume as much matter as would ordinarily make two stout octavos. We consider Trautwine's "Pocket-Book," having reference to the variety, amount and utility of its contents, to be the cheapest professional work in the market, and the best investment that a professional man without it, can make.

The Molder's and Founder's Guide. A Treatise on Molding and Founding in Green Sand, Dry Sand, Loam, and Cement; the Molding of Machine Frames, Mill Gear, Hollow Ware, Ornaments, Trinkets, Bells and Statues; Description of Molds for Iron, Bronze, Brass, and other Metals; Plaster of Paris, Sulphur, Wax, etc.; the Construction of Melting Furnaces; the Melting and Founding of Metals, the Composition of Alloys and their Nature, etc. By Fred. Overman, M.E. A new edition, to which is added a supplement on Statuary and Ornamental Molding, Ordnance, Malleable Iron Castings, etc., by A. A. Fesquet. Illustrated by forty-four engravings. Philadelphia: Henry Carey Baird & Co. 1880. 342 pp., 8vo. Price $2.

This is a new and considerably enlarged edition of a standard practical work which is well known to many of our readers. The publishers explain in their preface that they have endeavored to supply certain important matters that were not treated of in the original edition, by the addition of a supplement that brings it up to the present time, by embracing therein the results of the best current practice. We have carefully examined the supplemental portion of the volume, and have found it to contain much useful and valuable information respecting the more elaborate and difficult branches of the founder's art. From an inspection of the very detailed title-page which we have reproduced, the reader will observe that the work treats of every subject on which it is probable that the molder and founder will need to be informed. With respect to the style of the work, we may add that the information it gives, is presented in as clear, concise and practical a manner as the subjects treated of will admit.

American Newspaper Directory, 1880; containing accurate lists of all the Newspapers and Periodicals published in the United States, Territories and the Dominion of Canada; together with descriptions of the Towns and Cities in which they are published. New York: Geo. P. Rowell & Co.

The typography and binding of this book are all that could be desired; the taste displayed throughout is excellent; the type sharp and clear; and the ink of the best quality. The arrangement of the contents is also to be commended, and as a ready-reference book for titles of papers, their publishers and offices of publication, this directory is of much value.

There is one decided blemish, however, in this otherwise meritorious volume, that renders it worthless as a guide to advertisers. We refer to the statements of circulation. It is a matter of no importance what means Messrs. Rowell & Co. have employed to obtain their so-called ratings, nor are that firm's methods and motives (although well known) of any moment to respectable publishers, so long as their business is not interfered with. But when a book like this is issued, filled with fictitious figures, it is time to ask what right Rowell & Co. have to ignore the statements made to them by publishers themselves, and estimate circulations according to their own ideas, which, however weighty, will be ignored by intelligent advertisers, whom experience has taught that a few good city mediums are worth more than all of Rowell & Co.'s "select" lists of country newspapers put together.

American Health Primers. "Sea-Air and Sea-Bathing," by John H. Packard, M.D. Philadelphia: Presley Blakiston. 1880. Price 50 cents.

Dr. Packard, in this very readable little volume, defines the objects of bathing, the different classes of baths, and their special advantages. Following this is a chapter of considerations as to sea-side resorts, wherein the author very lucidly explains the hygienic value of sea air as a tonic and stimulant. Bathing in the sea is next considered, the author advising his readers how long to bathe, when and when not to bathe, how to bathe, and how often to bathe, besides giving useful hints as to the bathing of children and old people. Next follows a chapter on the treatment and resuscitation of the apparently drowned, in which Hall's, Silvester's, Howard's, and the Michigan method are each fully described, with the author's comments. Then follow chapters on sea-bathing for invalids, amusements at the seashore, cottage life at the seashore, the seashore as a winter resort, and on sanitary matters.

The book is written in a very pleasant style, and the topics treated of are presented in a very interesting manner, so that in addition to its value as a health guide, the seaside sojourner will find it to be a most entertaining book. We would suggest to all intending seashore visitors to take it along with them.

OTHER PUBLICATIONS RECEIVED.

Annual Address, American Society of Civil Engineers, read at the twelfth annual convention of the society, held at St. Louis, Mo., May 25th, 1880.

On the Variation Due to Orthogonal Strains in the Elastic Limit in Metals, and on its Practical Value and more Important Applications. By Robt. H. Thurston, A.M.C.E., Member A.S.C.E. New York: American Society of Civil Engineers.

Summary Statement of the Imports and Exports of the United States for the month ended April 30th, 1880, and for the ten months ended the same, compared with the corresponding periods of 1879. Prepared and published by the United States Bureau of Statistics. [Corrected to June 9th, 1880.]

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of THE MANUFACTURER AND BUILDER. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2658) COMBUSTION OF WOOD BY LIME.—What causes the combustion of wood in contact with lime? What process occurs to produce the combustion?—C. L. S., Auburn, N. Y.

(2659) SPOTTING OF LOOKING-GLASSES.—Please explain what causes the spotting of looking-glasses. I have often noticed it, and have several in my house that are nearly worthless, seeming to be covered over half their surface with a multitude of little specks. One of these was a large and valuable pier-glass, but is now almost useless as a reflector. It would be a satisfaction to me to know the cause of this, and whether it is possible to avoid it.—T. R. W., JR., Steubenville, O.

(2660) WHY A SMALL WIRE CASTS A BROAD SHADOW.—I would like to get an answer through the MANUFACTURER AND BUILDER as to the reason why a telegraph wire, an eighth of an inch diameter, casts a shadow 16 to 20 times its own diameter. I noticed this on a street in our city lately, the wire running north and south, and the shadow about 2 inches across.—A. M. B., Buffalo, N. Y.

(2661) TO REMOVE GLASS STOPPERS.—What is the easiest and quickest way of removing obstinate glass stoppers?—B. F. S., Annapolis, Md.

(2662) BLISTERING OF PAINT AND VARNISH.—How can I prevent the blistering of paints and varnishes on wood-work? It often occurs in spite of the greatest care in selecting and laying on, and if there is any way of preventing it completely, I would be obliged to you for the advice.—E. N. K., Lancaster, Pa.

(2663) CLOUDING OF MIRRORS BY MOISTURE.—Is there not some simple plan for preventing the clouding of a looking-glass by vapor from the breath, or a warm bath? I find it a great nuisance in shaving. I know this may appear to you a very unimportant question, but I really think a remedy for the above would save many, who, like myself, do not visit the barber to be shaved, from annoyance.—B. W. P., Lynchburgh, Va.

(2664) SELECTION OF A TELEPHONE.—I desire to purchase a telephone for use between our offices, situated about 300 feet apart. Can you direct me to some one of whom I can purchase? I want a good one—one using a small battery. I want one that will transmit messages perfectly distinct, as I shall use it for transmitting figures.—R. K. B., Athens, Ga.

(2665) TO LEARN PHOTOGRAPHY.—As I see you are very accommodating in giving advice, I take the liberty of asking for some information. I am a young married man, crippled, not able to do hard labor, and would like to learn some light business, such as photographing, for which I have a great desire. I would like to know the best and cheapest way to learn it, how long it would take, and about how much it would cost for instruments, chemicals, etc., sufficient to make a start. By answering the above, you will oblige.—J. M., Montville, N. J.

(2666) THEORY OF THE INJECTOR.—In one of your early issues, please explain the action of the injector for feeding boilers, and oblige.—E. O. S., Lexington, Ia.

(2667) THICKNESS OF HUMAN HAIR.—Will you please inform me what is the average thickness of human hair. Will you be kind enough to publish some of the most marvelous feats of minute workmanship that have been accomplished.—S. H. G., Philadelphia, Pa.

(2668) RUBBER SIZE FOR CANVAS.—Will you be kind enough to give me a recipe for rubber size that I can use on canvas, that will not crack and stand a temperature of 95° to 105°. An answer will much oblige.—A. B., Jersey City, N. J.

(2669) FINE GLOSS ON LAUNDRIED LINEN.—What do laundresses use to give a very fine gloss to linen?—R. P. R., Brooklyn, N. Y.

(2670) HEATING A CONSERVATORY.—Being about to join a small conservatory to my dining-room, I have thought that I might conveniently heat it by means of a stove in the room which it adjoins; but in that case would have to conduct the smoke through a flue below the plant tables, in order to reach the chimney. Would it be satisfactory in the long run to do so?—that is, would there be certainty of a good draft all the time, the smoke having to descend a foot or two on issuing from the stove, on account of the necessity of having the flue under the plant tables? Could you suggest a better plan? Any information through your columns would greatly oblige.—C. A. E., Iowa City, Ia.

(2671) EARLIEST BOOK AND NEWSPAPER.—Where was the first book printed in America? what was its title? and who was its printer? Also, where was the first newspaper printed? and what was its name?—B. S., Decatur, Ill.

(2672) LUSTROUS BLACK ON WOOD-WORK.—Can you inform us how we can put a fine black lustrous polish or finish on turned work, either in the lathe or after it is taken out?—J. R. H. & Co., Mallett Creek, Ohio.

(2673) CRYOLITE.—I enclose with this a small mineral specimen, which seems to have several commoner ones associated with it. I will thank you to give me its name. I have received a number of pieces of the same mineral with others, so you need not send it back.—J. N., Burlington, N. J.

(2674) COLORING GLASS TOYS.—How are the glass spheres and other toys, so generally used for decorating Christmas-trees, colored?—P. S., New York City.

(2675) BLACKBOARDS.—Can you give me a good composition for making a blackboard for school-room purposes?—C. S., Vandalia, Ill.

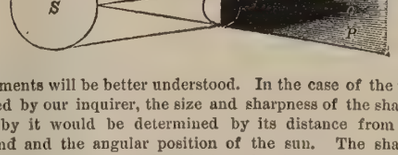
REPLIES.

(2625) "JIJUCS," AN UNKNOWN MECHANICAL TERM.—The following note, just received from John Wiley & Sons, publishers of the "Boston Machinist" (Fitzgerald), explains away the mystification surrounding the word "jijucs," concerning which C. L. N., of Worcester, Mass., asked for an explanation in our May number: "In answer to your note, we would say 'jijucs' has occasioned much comment and query, but when we tell you it is a misprint for 'jigs,' you will probably be amused."

(2658) COMBUSTION OF WOOD BY LIME.—This question is a most interesting one. The inquirer makes the assumption, evidently, that sufficient heat is liberated in the slaking of lime, to set fire to wood, and asks the cause and the nature of the process. We have never observed the combustion of wood by lime, although we are assured on excellent authority that it occasionally occurs. We have been told that accidents of this kind have repeatedly occurred on the lime cars of the Philadelphia & Reading Railroad Company; and the manner in which our correspondent puts his question, indicates that he must have observed the same phenomenon. On consulting authorities on the subject, we find a notable absence of reference on this point. We find enough, however, to justify us in the belief that the ignition of wood by lime is quite possible. The cause will be understood from the following explanation: Burnt lime, or quicklime, when moistened with water, at first absorbs it, but soon combines with it chemically, forming a hydrate of lime (or, chemically speaking, a hydrate of the protoxide of calcium). This chemical operation is called in common parlance, the "slaking" of lime. To satisfy its affinity for water, 100 parts—by weight—of lime require about 32 parts of water (or say three volumes of lime to one of water). The combination takes place, as every one is aware, with great energy, and considerable heat is evolved. Ordinarily, that is, where no great amount of lime is slaked at once, the temperature will not rise much above 300° Fah.; but where a great bulk of lime is brought in contact with water, either purposely or accidentally, the slaking takes place with great violence, and the mass becomes intensely heated. Graham (*vide* "Elements of Chemistry," Bridges) says: "In this combination, the temperature rises sufficiently high *to char and kindle wood.*" The "Handwörterbuch d. reinen u. angewandten Chemie," (Liebig, Poggendorff & Wöhler), under the caption "Hydrated Lime," says: "Das Wasser wird unter starker Wärmeentwickelung aufgenommen die sich bei grossen Massen bis zum Glühen steigern kann." A liberal translation of which would be as follows: "The taking up of the water is accompanied by the development of considerable heat, and where a great quantity is slaked, the mass may become *heated to redness.*" These authorities seem to us to be sufficient to establish the fact that enough heat is liberated, under favorable circumstances, to raise the temperature of wood that may be in contact with the mass considerably above the point at which it will take fire and burn. The process of firing the wood is the same as that which occurs when wood is ignited under ordinary circumstances. It is subjected, by the excessive heat of the slaking lime, to a species of destructive distillation; it is gradually charred, and gives off inflammable hydro-carbon gases, which take fire on contact with atmospheric oxygen, and this ignition is communicated to the wood itself. It will hardly be necessary for the lime to become heated to redness in order to ignite wood, since it will begin to char before this temperature has been reached—in fact, this will take place at a temperature not exceeding 450° or 500° Fah., and the charred surfaces will ignite, according to Pelouze and Fremy, at from 580° to 660° Fah.; and very dry wood at about 800° Fah. We are not accurately informed as to the precise temperature required for the ignition of many substances, and it is, therefore, hazardous to state the *lowest* temperature that will be sufficient to ignite wood, or the inflammable products of its distillation, but we feel confident that under the exceptional circumstances we have named, sufficient heat may be liberated in the slaking of lime to effect it. We shall be obliged to this correspondent, and to any others among our readers, for details of any cases of the ignition of wood from this cause, as we deem it both of scientific interest and of practical importance that they should be placed on record, to the end that more precise information respecting their occurrence may be obtained.

(2659) SPOTTING OF LOOKING-GLASSES.—The trouble of which this correspondent complains is a very common one, and is caused by undue exposure of the glass to the sunlight, or to the heat of a stove or fire-place. It is not as generally known as it should be, that the amalgam with which looking-glasses are coated to give them their perfect reflecting property, is very readily crystallized when exposed even for a short time to direct sunlight, or to strong heat from a stove or fire-place. A mirror hung where the sun can shine on it, is soon spoiled from this cause, taking on the granulated appearance our correspondent notices, and which will be familiar to all housekeepers. Where this action is allowed to proceed for some time, it involves the whole of the amalgam surface that is exposed, and the glass becomes worthless as a reflector. The continuity of its reflecting surface is destroyed, and it ceases to reflect the outlines of objects with precision. To avoid this trouble, care should be taken in hanging; if a glass is placed where the direct rays of the sun can strike it, it should be covered during that part of the day in which it is so exposed. It is better, of course, to hang it where it will not be exposed, but this is not always convenient, especially with large and expensive glasses, for which in modern houses there is usually provided a space for their reception. Where granulation has already commenced, its further progress may often be checked, and the glass preserved, by simply changing its position. As above remarked, looking-glasses will be spoiled as well by the action of heat as by that of direct sunlight. It is, therefore, important to avoid hanging a mirror near a stove or fire-place, where strong radiant heat will reach it. If this precaution is neglected, granulation is likely to occur, even in a comparatively dark room, from the action of heat instead of light. Another thing to be avoided, is having a lamp or gas jet burning too close to the glass, for though the heat may not be sufficient to crack the glass, it will often bring about the same injurious granulation. By observing the precautions above given, our correspondent, and many of our readers who may be similarly troubled, can avoid future difficulty from the same cause. We will throw out the hint to our correspondent, though he may already be aware of the fact, that his pier-glass can be re-silvered for about one-sixth or one-fifth of its original cost.

(2660) WHY A SMALL WIRE CASTS A BROAD SHADOW.—The phenomenon noticed by our correspondent, is simply that of the umbra and penumbra—that is, the total and partial shadow—produced when an opaque body intercepts the light from a luminous source which has a sensible magnitude. If the light be imagined to proceed from a single luminous point, and the intercepting opaque object has a sensible magnitude, a dark and well-defined shadow is cast, which becomes larger as its distance from the intercepting object increases. In such a case the shadow is total. Where, however, the luminous body has a sensible magnitude larger than that of the intercepting object, in addition to the dark shadow, or umbra, where no part of the luminous body is visible, there will be a much broader partial shadow, or penumbra, in which a part only of the luminous body is visible. The breadth of this partial shadow increases with the size of the source of light and with its (the shadow's) distance from the intercepting object. The darkness of the partial shadow increases gradually from the extreme border where it is so faint as to be barely visible, to the umbra or full shadow. By an examination of the subjoined illustration these



statements will be better understood. In the case of the wire named by our inquirer, the size and sharpness of the shadow cast by it would be determined by its distance from the ground and the angular position of the sun. The shadow will increase as the hight of the wire from the ground is increased, and will diminish as it is approached to the ground. The position of the sun, whether low in the horizon or overhead, will have the same effect practically, as the distance of the shadow from the object will be similarly affected. In the case named by A. M. B., the small size of the intercepting object—the wire—as compared with the apparent size of the sun, and its hight from the ground surface on which the shadow is cast, makes it obvious that the shadow seen is entirely a partial shadow, and if it were examined at intervals during the day, its magnitude would be found to vary as above explained. By simply taking a piece of wire, or better, a slender rod (to avoid vibration), and examining the shadow it casts when approached near to the ground, or elevated from it, our correspondent will be able to verify the above description of the wire shadow for himself. He will find the shadow, when the rod is close to the ground, to have about the same diameter, and to be very dark and sharply defined; as he elevates it, he will notice the shadow enlarging in diameter and gradually growing lighter, and less distinct on the borders; and could he elevate it high enough, the shadow would become so faint as to be quite indistinguishable.

(2661) TO REMOVE GLASS STOPPERS.—Glass stoppers that have become tightly fixed, which occurs very frequently with bottles in the chemical laboratory and the pharmacy, may be best and most safely removed in the following manner: Wipe the neck of the bottle perfectly dry, and then hold it for a few seconds about half an inch above the flame of an alcohol lamp, or a small flame of the Bunsen gas burner. The bottle should be rapidly turned while the neck is being heated, and care taken that the flame does not strike the glass directly, as this might crack it. The object of this procedure is to expand the neck of the bottle, by which its clasp on the stopper is loosened. For this purpose, the neck alone should be heated, and

by rapid turning, evenly heated all around. This being done, a steady pull and twist almost invariably succeeds in bringing out the most obstinately adhering stopper; if not, then a tap on the stopper with a block of wood will start it, when it may be easily withdrawn. It has been recommended to wrap a strip of cloth about the neck of the bottle, and pour hot water upon it for the same purpose; but though this plan is probably the safer of the two, it is by no means so sure to effect the object, as it is more difficult to avoid heating and expanding the stopper along with the neck. But if the above directions with the flame are carefully followed, an accident will rarely occur. The thing to be avoided in this operation, is heating the neck too hot; a few seconds of heating, as described, will in most cases be found sufficient for the purpose.

(2662) Blistering of Paint and Varnish.—The cause of this trouble is the presence of moisture that is confined under the shell of paint or varnish, and when heated, either by exposure to the sun or otherwise, the expansion of this moisture by evaporation gives rise to the very common trouble our correspondent complains of. The moisture may be due to the fact that the wood was not properly seasoned, or to the fact that it had not been thoroughly dried after steaming to facilitate bending to shape, or it may have been wetted in the manufacture; or it may be that it is to be blamed on the oil, as this often contains water moisture when steam has been used to express the oil from the seed; or it may be due to the evaporation of the turpentine, which is an extremely volatile liquid. In all cases, it is the effort of particles or bubbles of moisture, expanding or vaporizing by the heating of the painted or varnished surface, to reach the air, that causes the trouble. If the coating is very elastic, it may only raise a bubble or blister; while if it is hard and unelastic, it will crack it in escaping. Another form of this same kind of trouble is what is technically called "dry blistering." This is supposed to be due to the absorption of the liquids from the outer coats by paint or putty underneath. This deprives the outer coats of their adhesiveness, and causes disintegration, To avoid these various troubles, requires constant care and vigilance in the selection of materials, in applying them, and in seeing that the wood is perfectly dried. Every place to which moisture can find its way should be carefully stopped up, and each coat should be allowed time to dry out before laying on another. By observing these rules, the trouble will be avoided in the great majority of cases.

(2663) Clouding of Mirrors by Moisture.—The question this inquirer asks is by no means so unimportant as he appears to think. The clouding of a looking-glass in the vapor-laden atmosphere of the bath-room, or from the breath, may be simply an annoyance to one who is shaving, but in the use of many instruments in operative surgery, the several forms of speculums, the laryngoscope, etc., and in astronomical observations, the formation of dew on the lenses of telescopes, are very serious impediments to the operator and observer. The trouble, however, may be simply and effectually obviated by passing lightly over the surface of the glass or speculum a cloth or sponge slightly moistened with glycerine. Glycerine has considerable avidity for moisture, and in consequence the vescicles of water vapor contained in the expired breath or in the moist atmosphere of the bath-room, in touching this surface are instantly dissolved, so that no cloud is formed. If B. W. P. will try this simple recipe, he will find himself relieved of the annoyance he complains of, and will be able to shave in peace. We can particularly recommend this simple and effective remedy against the tarnishing of mirror surfaces by moisture, to the medical profession, as vastly more practical and better than the practice now in vogue of dipping them in tepid water or heating slightly over a lamp before using their instruments, as by the simple use of glycerine in the manner we have described, there will be no fear of giving the patient an unpleasant or painful sensation by accidental overheating of the mirror when applied to sensitive or inflamed parts; and the glycerine keeps the mirror from tarnishing long enough to suffice for half a dozen operations, whereas, in the old way, the mirror, by radiation and conduction, soon loses its acquired heat and becomes clouded again, often before the operation or observation is finished. We would say to B. W. P. in conclusion, that his question points the moral that trifling things are not to be despised.

(2664) Selection of a Telephone.—Replying to this correspondent, we must inform him that he cannot purchase a telephone. The plan adopted by the Telephone Company, is to *lease*, not to *sell*, the instrument. The telephone business in this country is now in the hands of a single company, which has purchased or otherwise secured control of all the telephone patents, including those of Gray, Bell, Phelps, Blake and Edison. This company is known as the National Bell Telephone Co., with headquarters in New York. This company has established numerous local and sectional organizations, and the company having control of Southern business is called the Southern Bell Telephone and Telegraph Co., with chief office at 197 Broadway, New York, and a general representative or agent, whose address is James M. Ormes, Agent Bell Telephone Co., Richmond, Va. Our correspondent will receive all necessary information respecting the lease of a telephone, by addressing Mr. Ormes at Richmond, or J. A. Brenner, Superintendent Southern Division Western Union Telegraph Co., Augusta, Ga., as the latter company is understood to be largely interested in the telephone company. The instruments now used by the telephone company are all supplied with the Bell "receiver" and the Blake "transmitter," which have been found to give the most satisfactory results in practical use, and which would serve our inquirer's purpose very well.

(2665) To Learn Photography.—It is a common practice among photographers to take learners under instruction. The usual charge, in the cities of New York and Philadelphia, will vary between $75 and $100. The pupil is instructed in such details as are essential in taking a picture, including the standard recipes for making the sensitizing bath, developers, etc., the preparation and subsequent manipulation of the plates, printing, use of the camera, lighting and pose of subject, and other essential points. To acquire such a familiarity with these purely mechanical details of the art, sufficient under ordinary circumstances of practice to take a passable picture, may require about three or four months of steady application. But there will be a vast amount for the pupil yet to learn, that he will only acquire in the actual practice of the art, as difficulties arise and have to be overcome; and when he commences business for himself, his actual period of hard study and work will fairly begin. This is only to be expected, for the proper understanding of photography demands that the operator should have some familiarity with the chemistry of the reagents he handles and uses, and with the laws of light. The expense for instruments, chemicals, and the like, for practice in an ordinary town or village, will probably be about $150 to $200, and the expense of fitting up an office will vary according to the means and ideas of the operator. The advice we give to our correspondent, is this: Get the addresses of some of the *best* photographers in New York or Philadelphia, and open correspondence with them as to their terms for taking you as a learner, giving you references as to character and ability. Having made a selection from this class of operators, you will be sure of getting the best kind of instruction, and the best advice as to the kind and cost of instruments, furniture, etc., you will need when you leave. Do not go to some indifferent operator, because he happens to be cheap, for such a course will cost you more in the long run. The knowledge you will gain by serving your time with a master of the art, will be worth far more to you than the few dollars you may save by going to one of the other kind.

(2666) Theory of the Injector.—The explanation of the action of this apparatus which is generally accepted as the correct one, we give below, substantially as given by Knight. It should be added, however, that there are a number of peculiar features about the action of injectors which are not fully understood, or, at least, upon which engineers are not entirely agreed as to their proper explanation. The general principle of their action may be stated, however, as follows: Under a given pressure, the velocity of escaping steam is much greater than that of the water which would be ejected were a hole opened in the boiler below the water-line. At a pressure of say 90 pounds to the square inch, the excess of velocity of the steam is about in the proportion of 9 to 1. As the escaping steam, in being condensed, loses none of its velocity, except that due to the friction of the pipes through which it passes, it consequently, after condensation, has a penetrating force about nine times greater than the resisting force of the water in the boiler. At the moment of condensation, it imparts its momentum to the water by which it is condensed, and with which it mingles. For instance, 1,700 cubic inches of steam, on being condensed to one inch of water, imparts sufficient momentum to 8 cubic inches of water, by which it is condensed, to exactly balance the pressure of water in the boiler. In this case the opposing forces are in equilibrium; but, combined with any less quantity of water, say 7 cubic inches, the momentum will much more than suffice to overcome the resistance of the water in the boiler, and the mingled condensed steam and water will force its way into the boiler if a properly constructed entrance be provided for it.

(2667) Thickness of Human Hair.—There is considerable difference in the size and number of hairs on the human body, and they vary according to individual peculiarity, age, sex and race. As regards size, by which we mean length and thickness, Kölliker distinguishes three varieties, namely: 1st. The long, soft hairs of the head, which vary from about 6 inches to 3 feet in length, and are from one-600th to one-240th of an inch in thickness. 2d. The short, stiff and thick hairs found at the entrance of the nostrils, in the external ear passages, and the eyebrows and lashes. These have an average length of about ¼ to ½ of an inch, and a thickness of from one-400th to one-170th of an inch. 3d. The short, exceedingly fine hairs, usually called "down," found on the back of the hands and distributed over the body. These are usually one-6th to one-4th of an inch long, and have a thickness of one-2,000th to one-1,200th of an inch. The number of hairs to a given surface, varies also, according to age, sex, color, etc. Wolf, for example, who has examined the hairs of the human head for this purpose, found on a surface of ¼ of a square inch, 147 black, 162 brown, and 182 fair hairs. On a moderately hairy man, he found on ¼ of a square inch of surface, 293 hairs on the scalp, 39 on the chin, 34 on the pubis, 23 on the forearm, 19 on the back of the hand, and 13 on the front of the leg.

We will bear this correspondent's second request in mind, and publish at an early and convenient time an account of some of the most remarkable examples of minute workmanship.

(2668) Rubber Size for Canvas.—Take a pint or quart (according to quantity of size required) of oil of turpentine, or, better still, bisulphide of carbon; add to this from time to time crude rubber (Para gum is the best) cut into small pieces. Cover the vessel closely to prevent the evaporation of the solvent, and stir it about occasionally to facilitate the softening of the rubber. Do not add much rubber at one time, as it swells enormously, and too much may be added by mistake. When the rubber has been brought to the uniform consistency of a thick paste, take a portion, thin it down considerably with oil of turpentine, and apply with a brush to the canvas or cloth. Of the rubber solution remaining, take as much as may seem necessary, add to it about double its volume of boiled linseed oil, and boil, with occasional stirring, for about an hour, or until the whole forms a uniform liquid; then add to this double or treble its volume of boiled oil, and enough litharge or other good dryer to give the varnish good drying qualities, and apply warm over the first rubber coating.

(2669) Fine Gloss on Laundried Linen.—We do not believe that the secret of imparting a high gloss to linen lies in the use of any particular substance. Gum arabic, white wax, paraffine, spermaceti, and other things of that nature, have been suggested for the purpose, and are no doubt used to a greater or less extent; but the real secret of success in artistic laundry work, we believe lies in the character of the iron used for the purpose, and the skill with which it is handled. A heavy, self-heating iron, we believe, is generally used by professionals. The iron should be hard, heavy and finely polished, and should be rounded at the point, to permit of great pressure being brought to bear on a small space of the article instead of being spread over the whole face of the iron. Any of the above mentioned additions to the starch will improve the quality of the work; but the quality of the iron, and its shape and weight, and the dexterity of the hands in its use, are the prime essentials of success.

(2670) Heating a Conservatory.—If the flue draws well under ordinary circumstances, we do not think that our correspondent will have any trouble with it by making the connection he proposes. The carrying down of the stove-pipe a foot or two would not materially impair the draft; and with the above proviso, we are of the opinion that the plan he suggests would be found to answer satisfactorily. Should the chimney in question, however, happen to be surrounded by high buildings, a circumstance that would occasionally cause eddies and down-drafts, it would be well to provide it with a good cowl or chimney-cap, as a precautionary measure. It may also possibly be found necessary in starting with a cold flue, to get it to drawing well, to have the aid of a temporary wood fire, in a stove or grate communicating directly with it, before starting the other. This, however, is but a trifling inconvenience.

(2671) Earliest Book and Newspaper.—It is said that printing was first introduced into America by the Spanish Viceroy Mendoza, at the City of Mexico, in the year 1536; and the first book published is believed to have had the title "Escala espiritual de San Juan Climaco." No copies of this work are known to exist at present, and the name of the printer is a matter of doubt. In what is now the United States, Cambridge, Mass., has the honor of having first introduced the printing-press. This was about the year 1638. Stephen Daye was the first American printer, and his book was the "Bay Psalm Book," issued in 1640. The first newspaper was issued at Boston, by John Campbell, on Monday, April 24th, 1704. It was called the *Boston News-Letter*, and was regularly published for about seventy-two years.

(2672) Lustrous Black on Wood-Work.—We know of nothing that will be expeditious enough to answer our correspondent's inquiry to put a fine, black, lustrous finish on wood-work in the lathe; but can give him several recipes for putting on a black finish afterwards, namely: Put on two coats of black japan, then varnish or polish; or use size and lampblack before laying on the japan. Or, wash the wood with a boiling decoction of logwood three or four times, allowing it to dry between each application; then wash with a solution of acetate of iron (made by dissolving iron filings in vinegar), and varnish or polish. Do not mix the logwood and iron before application. This stain is so deep that ordinary scratching will not expose the original color of the wood.

(2673) Cryolite.—The mineral specimen inclosed is called Cryolite. It is a double fluoride of sodium and aluminum. The minerals associated with it are pyrite (iron pyrites), galena, and spathic iron. The specimen is doubtless from Greenland, from which country it is obtained in considerable quantities, and used in the manufacture of soda bicarbonate and alum. Any good work on descriptive mineralogy—Dana's, for example—will give you all additional facts of interest respecting the mineral.

(2674) Coloring Glass Toys.—The mode of coloring these and similar toys, no doubt differs somewhat. One method, and we think the simplest, consists in preparing a solution of collodion—gun-cotton gelatinized in a mixture of alcohol and ether—adding to it an alcoholic solution of one of the aniline colors that gives the desired tint, filling the spheres with this colored solution and then emptying out the surplus. The portion remaining in the interior, by the evaporation of the solvent, speedily forms a tenacious coating of the desired color, having the high luster which is characteristic of these and similar toys. Our correspondent will find this to be a rapid and satisfactory method of accomplishing his object.

(2675) Blackboards.—Apply the following mixture to the framework made of well-seasoned pine: Take powdered pumice-stone and incorporate with shellac varnish, then add enough lampblack to give the mixture the desired color, and apply a smooth coating to the board with a flat brush. Several applications may be necessary.

THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 9. SEPTEMBER, 1880. TWELFTH YEAR.

Barking Machine for Wood-Pulp Makers.

One of the most interesting special wood-working machines that has lately come to our notice, is that shown and described below, and has been called into existence by the necessities of one of the most recent and flourishing of our domestic industries—the manufacture of wood pulp for paper-making. The machine in question is designed to cut or shave the bark from the round log after it has been cut up into proper lengths for the pulp machine.

By reference to the accompanying engraving, the reader will see at a glance the adaptability of the machine for the special work for which it is intended, and will not fail to be struck with the simplicity and ingenuity manifested in its construction. It consists essentially of a heavy cast-iron annulus, similar to that of a stave or shingle jointer, faced up in a lathe and accurately balanced. The annulus runs vertically on an iron arbor with babbitted boxes, the whole setting in a heavy wooden frame. The working face of this disk is provided with a series of broad steel cutters (five in number), disposed at equal distances from each other, and set at an angle so as to give the most effective shearing cut. These cutters are adjustable, so that as they wear down they may be set forward. In front of the machine is a horizontal stand or table, on which the log to be barked—cut to the proper length for the pulp machine—is rested on end, and fed up to the revolving cutters by hand. The machine cuts away the bark in fine shavings, down to the fiber of the wood, with suprising rapidity, and the operator has simply to rotate the log by hand as may be required to meet the cutters. A set of fan-like projections behind the cutters carry the shavings away from the machine, and the barking of the log is accomplished with the utmost dispatch.

BARKING MACHINE FOR WOOD-PULP MAKERS.

The makers inform us that with the aid of their barking machine, one man will do the work of three men working as commonly done, with hatchet, broad-ax or shave, and that the work will be done in a far more satisfactory manner than is possible with hand-barking, and make a large saving in the stock usually cut away and wasted.

Three sizes of this machine are made, of 42, 45 and 54 inches circle, revolving respectively at 700, 625 and 550 turns per minute. The smallest machine will bark up to and including a log of 9 inches long, any diameter; No. 2 machine, to and including a 13-inch log; and No. 3 machine, to and including a 22-inch log.

These useful special machines are manufactured and for sale by Messrs. S. C. Forsaith & Co., of Manchester, N. H., who state respecting them that they are far behind their orders, the demand from wood-pulp makers having very greatly exceeded their expectations.

Kaolin and its Preparation.

At a late meeting of the United States Potters' Association, a committee on raw material made a report, in which they referred to a want of uniformity in the preparation of the clay or other material before sending it to the potteries, and also to the necessity of having the raw material, wherever found, carefully analyzed. The report further states that the committee visited the clay mines in Chester and Delaware counties, Pennsylvania, and several in the State of Delaware, and found, to their surprise, immense deposits of fine, pure kaolin clays, that, if properly worked and developed, will furnish clay enough to last all the potteries in this country for a century. These pits, when opened, were worked in a wasteful and slovenly manner; but a change has been made in this respect within the past two years, by the introduction of improved machinery, by which the clay will be furnished free from iron and other impurities.

When the kaolin is taken from the earth at these mines it looks like lime, and quite solid, and, after being loosened and broken up, is shoveled into a hopper, through which it passes into a receiver. This receiver is a box, about 15 feet long, and from 2 to 3 feet high and wide. Through this box runs an iron shaft, having projections at intervals like blades of a knife. As the shaft revolves water is admitted into the box, thus dissolving the lumps, and, with the assistance of the blades, reducing the clay to powder, and leaving the receiver in the form of a whitish liquid. In this condition it is passed through a sand trough some 12 feet long, a current of water keeping it in motion and at the same time allowing the sand in the kaolin, which is the heaviest, to settle in the bottom of the trough. The liquefied kaolin is carried on and back and forth through boxes, where the mica is separated from the kaolin, a process more difficult than getting rid of the sand, as the mica is much lighter. After this process is completed, the still liquefied kaolin is passed through very fine gauze screens, which have the effect of rendering the substance still more pure. From the screens it is conveyed into large tanks or vats, where it remains about twelve hours. When it is found that the kaolin has settled at the bottom, with the water on the top perfectly clear, the water is drawn off and the kaolin transferred, by means of pumps, to hydraulic presses. These presses are each about 12 feet long and 6 feet wide, the bottom being lined with zinc. Each press contains 34 leaves, having small openings between them, in which linen bags are placed to receive the kaolin. The leaves are kept in their places by iron rods, and when the openings are filled the pressure is applied with sufficient force to remove all the water and leave the kaolin in a compact form in the bags. When the leaves are opened, the clay is found in cakes 6 feet long, 22 inches wide and ¾ of an inch in thickness. From the presses the clay is put in an open shed, or in the open air when the weather is hot, for thorough drying; then it assumes a nice whitish color, and is ready for shipment.

Motive Powers of the Future.

A suggestive paper was recently read before the Liverpool Engineering Society on the "Utilization of the Tides," by Mr. Oates, of Bradford. He was of opinion that although the coal supply of England would last for a long time to come, yet that ultimately the power of the tides would outrival all other sources of mechanical power. After pointing out that the ways of utilizing the tides were innumerable, and describing the construction of the tidal dam with suitable converters of the power, such as turbines in openings of the dam, working air-compressing or magneto-electric machines, he stated that the necessity for large conservators for storing the power between the tides would be the greatest difficulty in utilizing their power. A description of how this could be done, and the power rendered constant, was given. The means of conveying the power to a distance was then considered, air and water pressure and electricity being suggested. With regard to the latter, Mr. Oates believed that the "age of steam" had reached its zenith, and that the "age of electricity" had dawned; but should there be difficulty in conveying the power to a distance, he suggested that manufactories might be built adjacent to suitable tidal sites.

The Manufacturer and Builder.

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Vol. XII. No. 9. TWELFTH YEAR.

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Extra Edition of October Number to General Manufacturers.

The special numbers of the MANUFACTURER AND BUILDER issued during the past two years, have met with such genuine appreciation from the particular lines of manufactures to which they were devoted, and from advertisers, that we have decided to publish an extra edition of 10,000 copies of our October number, for distribution among the principal manufacturing establishments throughout the country, not confining our list to any special line, as heretofore, but including all branches of manufactures. We call special attention to this extra number, and trust that we may receive the same liberal patronage that we have been favored with in the past. Applications for space should be made at once by those wishing to secure desirable locations. Rates for advertising will be the same as for our ordinary editions, notwithstanding the great special inducement offered.

The Foreign Trade of the United States.

Mr. Joseph Nimmo has issued, under date of July 24, 1880, a preliminary report on the foreign commerce of the United States, from which we make the following summary: The report gives a number of valuable tables, showing the condition of the foreign trade of the country for a series of twenty-one years, from 1860 to 1880 inclusive. From these tables it appears that during the year ended June 30th, 1880, both the imports of merchandise into, and the exports of merchandise from the United States, were larger than during any preceding year in the history of the country. As the reproduction of these tables would take up more space than we can devote to them, we simply abstract such portions of them as have special bearing on the fiscal year just ended. For the year ended June 30th, 1880, the exports of merchandise from the United States amounted in value to $835,793,924 (of which $824,106,799 were domestic exports, and $11,687,125 foreign goods re-exported), and our imports during the same period amounted in value to $667,885,565, showing an excess of exports over imports of $167,908,359. The combined value of imports and exports of merchandise for the period named, equaled $1,503,679,489. The exports of merchandise during the year ended June 30, 1880, exceeded the value of exports during the preceding year by about $125,000,000, or 18 per cent; and the value of our imports exceeded that of our imports during the preceding year by about $222,000,000, or 50 per cent; while the combined value of imports and exports of merchandise during the fiscal year just ended, exceeded that of the preceding year by about $347,000,000, an increase of 30 per cent.

The growth of the foreign commerce of the country is strikingly apparent from a comparison of these figures with those of earlier years, from which it appears that the combined value of our exports and imports during the last fiscal year, as compared with that of 1870, shows an increase of 81 p. c.; and as compared with that of 1860, an increase of nearly 119 per cent. During the last fiscal year the excess of our imports over exports of coin and bullion, amounted to $75,891,391. From the above *resumé*, it will be seen that the condition of our trade during the past fiscal year was highly satisfactory, the balance being largely in our favor.

Another Kind of Inspection that Does not Inspect.

Another subject that is chronically afflicted with the curse of politics, that seems to blight and wither everything it touches, is the inspection of petroleum oil for home consumption. Our transatlantic neighbors, fully alive to the dangers of adulterated kerosene, exercise the most stringent species of inspection of every barrel arriving at their ports of entry, and all that fail to pass inspection are rigorously condemned. The consequence of this strict discrimination, has been that the refiners engaged in the foreign trade do not dream of shipping inferior oil; that is good enough—thanks to the kind of inspection in vogue—for this country; none but the best will do to send abroad.

To those who are fully acquainted with the subject, the facts in relation to the character of the petroleum oil sold almost everywhere throughout this country for household uses, are simply disgraceful. There is not a single State which has not on its statute books stringent prohibitions against the sale of adulterated petroleum, and we venture the opinion, without fear of contradiction, that there is not a single State in which the prohibition is not openly and flagrantly disregarded; and so long as the enforcement of the inspection laws regulating the sale of this commodity is left in the hands of that arch-pest of American society—the professional politician—so long will this state of things continue.

We give in another column a simple test which any person using kerosense can apply, and which will assure him of the comparative safety of the oil he is purchasing, in spite of inspectors, who inspect nothing but their perquisites.

A System of Sound Signals for Conversation Between Vessels at Sea.

We have received from Capt. Charles E. Bridge, of New York, an outline of a proposed system by which vessels at sea can hold conversation by sound, and which seems to us, from the examination that we have been able to give it, to contain some really valuable suggestions. Capt. Bridge introduces his proposal with the remark that "the advantages to be derived from rapid signal communication between vessels at sea, must be apparent to all, and the many accidents that have lately occurred, both at sea and on inland waters, seem to render it imperatively necessary that a more complete, systematic and sure means of communication should be established." With this statement, we are confident, all will agree. He then proceeds to show the inadequacy of the signaling system now in use.

They consist of (1) *the steam whistle*, only used at present for friendly salutes, or to indicate the passing either to starboard or port; (2) *private flag signals* (or lights at night), to indicate positive or fixed expressions, taking time to hoist and lower, and necessarily imperfectly filling the requirements of complete communication. What is needed, is a method by which messages of every character may be rapidly transmitted in all sorts of weather, and in every language; and this requirement Capt. Bridge proposes to meet by adapting the ordinary cipher employed by the United States Signal Service Corps in sight signals, to a system of simple sound signals, by which conversation may be carried on between vessels without difficulty, the ordinary alphabet being transmitted and received letter by letter. Each letter of the alphabet is represented by a particular number of long or short, or long and short (sharp or prolonged) notes of the whistle, horn or bell, and the end of a word by a stop. By means of this simple code, messages may be sent and received with the greatest ease and dispatch by persons quite inexperienced in this kind of work. The plan, it is said, has been tested and found to work very satisfactorily.

It will be readily understood by our readers, that to make the long and short notes with certainty, a simple arrangement of valves could be adapted for the purpose, the movement of one lever giving the short note and the movement of another the prolonged one. Capt. Bridge estimates that there would be no difficulty in sending an average of three words per minute by this means, and at this rate (which is not rapid for one accustomed to the work), the swiftest ocean steamers passing each other in opposite directions, would have ample time to exchange many messages; while sailing craft, unprovided with steam whistles, could communicate by means of fog horns and bells.

Capt. Bridge, it appears to us, has struck the right course in his suggestion to provide a ready and satisfactory means of signaling at sea. His plan has in it

the essential elements of simplicity, practicability and comprehensiveness. We trust he may receive proper encouragement from our naval authorities and shipping masters, to the end that it may be perfected and applied in practice.

We add in conclusion a brief *resumé* of the advantages of the proposed system, in Capt. Bridge's own words: "Among the many instances where this system would be of great service, would be the ability to signal the course, the name of the vessel and the line to which it belongs, the captain's name, the locating of icebergs or wrecks that one vessel meets and warns another of, distress of any kind, such as sickness on board, mutiny, shortness of water, leaks, or anything that has occurred out of ordinary. A regular signal telegraphy might be adopted for the use of passengers, for there must have been many times where out-going passengers would have given any amount to be able to transmit messages back to the port they had left, without waiting until they landed on the other shore. It might also be used when criminals fleeing from justice are found on board, etc.

"It only remains to say that the application of this method is simple and free from complications, and capable of being used under any and all circumstances, which render the mariner's path so precarious and complexing. The ingenuity of the machinist can be so easily brought to bear to render the working as simple as placing the hand upon a key-board; but the purpose of this paper will have been accomplished if those who read it will try for themselves the simplicity of the method. The only matter of surprise is, why it has not long since been in use with at least the steamship lines of the commercial world, for certainly a want must long have been felt for a more rapid and sure method of communication than any yet used."

Improved Terminal Facilities for New York.

The removal of legal obstructions to the building of the National Docks Railway through Jersey City, by the dissolution of an injunction granted by the Chancellor at the instance of the New Jersey Central Railroad Company, is looked upon as a decision of great importance to the commerce of this city.

As we have no interest in the rivalry of the several railway companies which figure in the legal dispute concerning these improvements, we shall simply give a brief description of their nature, from which our readers may judge of their importance. The National Docks Storage Company, a corporation which has for years handled the freight of the Pennsylvania Railroad Company, lately purchased considerable water-front on Communipaw Bay, in addition to its previous landed possessions there, and design to construct a system of piers out to deep water, alongside of which vessels can be brought and loaded directly from the cars of the railway companies without the necessity of breaking bulk. These piers are intended partly for the shipment of oil, and also for the storage and shipment of grain, cotton, tobacco and other Southern and Western freight products; and to this end, immense grain elevators and warehouses are to be built upon them, so that when these projected improvements are actually realized, the freight cars of the Pennsylvania Railroad Company can be run practically up to the sides of ships in deep water and unloaded, without incurring the expense of breaking bulk, which is at present a serious drawback to the foreign shipping business of this port.

The route of the National Docks railway which is to effect these substantial improvements to the terminal facilities of New York, will start from the Point of Rocks east of Bergen Hill, and run along the low grounds due south for about a mile to the shore of Communipaw Bay, crossing the tracks of the New Jersey Central Railroad Co., on an elevated trestle-work, near the Communipaw station. Skirting the shore in a southwesterly direction, it will curve to the rear of the old abattoir buildings, and thence to the works of the National Storage Company facing the island called Black Tom. From this point, the company has already a double line of tracks, laid on trestle-work, to a pier which rests on the island, and an immense warehouse, built of the materials of what was once Machinery Hall of the Centennial Exhibition. When all the contemplated improvements are completed, the company will have storage tanks for oil of a capacity of 1,000,000 gallons, immense grain elevators capable of storing hundreds of thousands of bushels of grain, and warehouses for receiving cotton, tobacco and other Southern and Western freights.

The benefits to be derived from these improved terminal facilities will not be confined to the Pennsylvania Railroad Company, since it is confidently expected that they will be jointly divided between a number of other roads whose tracks may be readily united with the system. Among these may be named the Erie, Delaware, Lackawana and Western, the Baltimore and Ohio, and the Reading. There will then be five leading railroads whose freight can be delivered directly on shipboard at the piers of the storage company.

New York has not kept pace with several other cities, notably Philadelphia and Baltimore, in providing terminal facilities for the cheap and expeditious handling of its immense freight business, and for this reason the decided natural advantages that she possesses in her harbor have been measurably neutralized. With the completion of the improved terminal facilities of the National Storage Company, these disadvantages will disappear.

A New Phase of Steamboat Inspection!

To the surprise of the public, and doubtless to the utter amazement of the parties specially interested, the Grand Jury brought in true bills of indictment against the officers and owners of the steamboat "Seawahnaka," the recent burning and explosion of which, with calamitous results to her living freight, will still be fresh in the memory of our readers. We hail this departure from the well-worn grooves of custom with especial gratification, not that we especially desire that the stockholders who owned the boat, or the officers who commanded her, shall be found guilty of manslaughter for their criminal indifference to the true condition of their boat, but for the reason that this action of the Grand Jury furnishes the unmistakable evidence that the public has at length wearied of the repeated collisions, explosions and burnings of steamboats which of late have occurred with alarming frequency and with terrible sacrifice of human life; and that the determination has been reached to find out who is responsible, and to hold him or them to strict accountability. But still more gratifying to the intelligent public must be the announcement that this same Grand Jury actually indicted the United States inspectors of steamboats and the inspectors of steam boilers, the officials whose duty it was to see that the "Seawahnaka" had fully complied with the laws, and that the condition of the boat and her machinery was safe.

We have previously been obliged to comment severely upon what we then termed the "farce of steamboat inspection," and now that the Grand Jury has done itself credit and the public good service by its determined effort to fix the legal responsibility of this calamity where it belongs, we will confide to our readers our suspicion that in indicting these officials, they have hit very close to the mark.

We have entered upon a new phase of steamboat inspection that will give serene satisfaction to steamboat passengers—we have begun to inspect the inspectors.

The Forty Days' Fast.

In spite of the almost universal predictions of medical men to the contrary, Dr. Tanner, a physician of Minneapolis, has actually succeeded in performing the unexampled feat of abstaining from solid food for a period of forty days, during the whole of which lengthened period he received nothing into his stomach except, at intervals, small quantities of water. The experiment was conducted with every appearance of fairness, and every reasonable provision against fraud was made by a number of watchers, chiefly members of the medical profession interested in the physiological aspects of the case, who relieved each other in keeping watch over the faster from the beginning to the close of the experiment. There is, therefore, no reason to doubt that the experiment was a genuine one.

With occasional exceptions, the physical condition of Dr. Tanner during his protracted starvation was surprisingly good, and probably the most singular thing in connection with the experiment, is the fact that no serious consequences followed it. The faster of forty days gorged himself with solid and liquid food for the succeeding week or two, and the stomach, apparently none the worse for its long rest, resumed its interrupted digestive functions as though nothing had happened.

Dr. Tanner, the principal in this remarkable performance, is a man 5 feet 3 inches in hight, therefore rather below the average, and weighed, just before beginning his experiment, 157½ pounds. The experiment began at noon on the 28th of June, and terminated at noon on the 7th day of August. At the close of his fast, his weight was 122 pounds, showing a loss of 35½ pounds.

Daily examinations were made of the faster's physical condition. The most interesting of these were the microscopical and chemical examination of the water voided, which showed a progressively diminishing quantity of urea, which is one of the best proofs, if any are needed in addition to the circumstantial evidence above stated, that the experiment was fairly conducted. These examinations were made by a former writer on this journal. The same party made another and highly interesting observation, showing remarkable changes in the blood of the faster. During the last hour of the fast a drop of blood was taken from the faster, and examined under the microscope. It was found that the corpuscles, which in the healthful state are smooth and rounded disks, having an average diameter of one-3,600th of an inch, were found to be smaller in size (about one-5,000 of an inch), and many of them ragged and irregular in shape, being covered with what appeared to be a fungoid growth. This appearance is said to be very similar to that observed in the blood of typhoid fever patients, and is an evidence of the deterioration of the blood. This, and other symptoms of physical derangement, rapidly disappeared during the first few days after the breaking of the fast. The nitrogenized substances in the urine, which had diminished to one-tenth of their normal quantity, trebled within 24 hours. The fungoid spores on the blood corpuscles likewise showed a marked diminution within 24 hours, and a few days afterwards the blood had become quite normal.

The experiment of Dr. Tanner does not prove that every one can go without food for so long a period as he has succeeded in doing; but it proves that, under certain conditions, the human body is capable of far more endurance in respect to abstention from food than has hitherto been believed.

The question has also been raised, in view of the manner in which Dr. Tanner indulged ravenously of everything nourishing immediately on the termination of his experiment, against the warnings of his medical advisers, meeting with no bad effects, but, on the contrary, gaining on an average 5 pounds each day, whether the customary mode of treating persons suffering from starvation, by giving them homœpathic doses of milk and brandy, etc., at long intervals, is not altogether wrong. These and other points in connection with this remarkable experiment, will doubtless be finally settled by the doctors.

We wish specially, however, to put Dr. Tanner's performance on record, as being the most reliable and best authenticated case of prolonged fasting that we have.

Nail Production.—The nail mills of the United States produce yearly about 4,000,000 kegs.

The Maxim Electric Light for Marine and other Uses.

In commenting lately (see our issue for July) on the disastrous collisions of two Sound steamboats, and of two ocean steamers which occurred a few days later, we took occasion to remark that these accidents could in all probability have been avoided had the vessels in question been provided with electric signal lights in place of the utterly inadequate oil lanterns with which they were provided. And on the same point we added, that the futility of trusting to these and fog-bells and whistles to avoid collisions, has been demonstrated again and again; while the power of the electric light to penetrate a fog has been shown to be infinitely superior to any form of light yet devised, and its efficacy as a safeguard against this class of accidents is out of all comparison superior to anything else. The use of electric lights should, therefore, be made mandatory on all steam vessels.

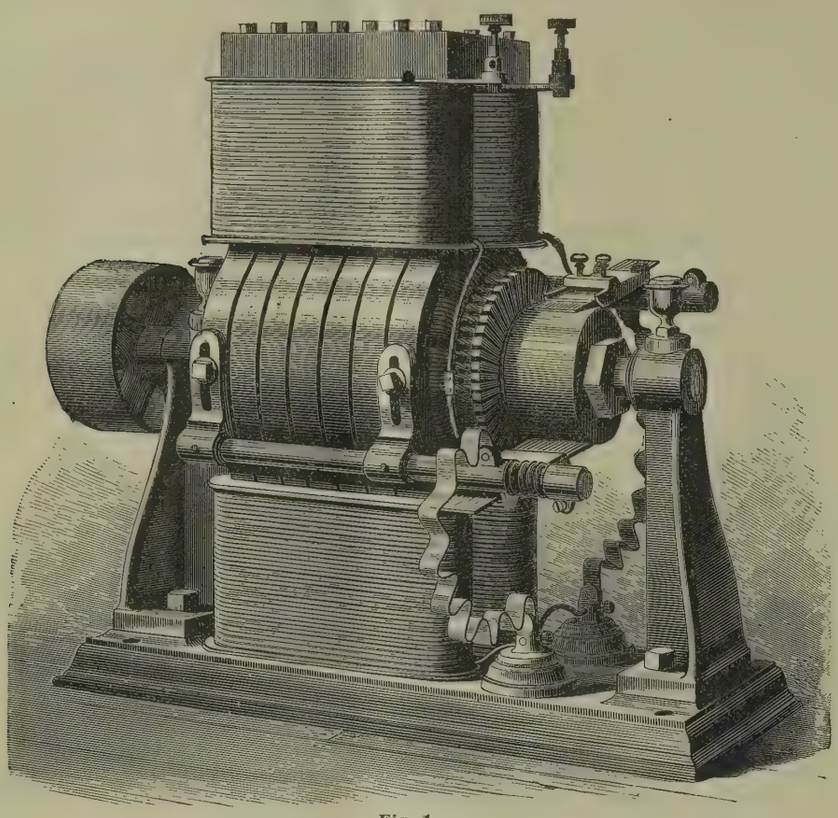


Fig. 1.

We are gratified to have the opportunity at this time of presenting to our readers the illustrations and description of an electric light apparatus specially designed for marine use, and which appears to possess every necessary and desirable feature that an apparatus intended for this special service should have. The apparatus in question is the invention of Mr. Hiram S. Maxim, a well-known inventor of electrical machinery, and is manufactured by the United States Electric Lighting Company, 120 Broadway, New York.

Referring to the accompanying engravings, Fig. 1 represents the electrical generator, or dynamo-electric machine of the Maxim system, and Figs. 2 and 3 show different forms of the electric lamp used with it. The dynamo-electric machine (Fig. 1) is provided with an armature of soft iron rings, with the wire wound parallel to the axis, and so disposed as to permit of the free circulation of air through the armature. This arrangement is designed to prevent the dangerous heating of the generator, which is one of the most serious impediments to the economical use of most of the machines of this class, whether of foreign or domestic manufacture, and is affirmed to answer the purpose very satisfactorily, even with the severe test of running the machine on a short closed circuit.

The large and heavy commutator has its sections curved in a right and left hand spiral, to avoid the occurrence of a break in the current. The machine is well built, compact and attractive in appearance, and on the score of performance and adaptability for its intended service, will compare favorably with the best machines of its class—a fact which has been amply demonstrated in competitive tests instituted for the purpose of comparing the merits of the several forms of dynamo-electric machines. The inventor has designed a small, high-speed engine for the special purpose of driving the generator directly, without the intervention of belts and pulleys; but the machine may, of course, be driven from any source of power that is available.

Referring now to the lamps, Fig. 2. represents the form of the device intended for use on land or for river steamboats. The details of its construction and operation will be found below in connection with the description of the lamp shown in Fig. 3, which is more elaborate, and is designed for ocean steamships. In all essentials respecting its working parts, the lamp shown in Fig. 2 is substantially the same. The front, or cover-glass is in strips, to lessen the danger of cracking from the intense heat evolved from the light.

Fig. 3 shows the form of lamp designed for ocean steamships. The exterior of the lamp is formed of a strong brass case, cylindrical in shape, mounted on a substantial base piece, and supported on trunnions, so as to be capable of being moved in any direction. Within the case is a silvered reflector of parabolic form, at the focus of which the carbon poles of the electric arc are located. The mechanism of the lamp, by which the position of the carbons in the focus of the parabolic reflector is maintained as they are consumed, is substantially the same as that previously described and illustrated in our October number for 1878, and to which we, therefore, refer those of our readers who wish for details that are not shown in the accompanying engravings. It will suffice to state in this place that the regulating apparatus is perfectly automatic in action, consisting essentially of an electro-magnetic device and appropriate gearing, controlled by the current passing to the lamp. By the action of this regulator, both the carbons are kept continuously in the same place, being fed upward and downward respectively, according to the rapidity of their consumption. This regulator is likewise one of Mr. Maxim's patented inventions.

The lamp may be raised or lowered, or moved forward and backward at will, and the carbon poles may be accurately adjusted in focus by means of regulating screws provided for the purpose. A small lens placed in the side of the reflector throws an inverted image of the carbons on a ground glass screen, so that an observer may note their condition and action without exposing his eyes to their direct glare. The whole apparatus is handsomely finished, and presents a very ornamental appearance. It is enclosed in such a manner that a heavy sea will not interfere with its action. When it is desired to cut off all light in the foreground and to

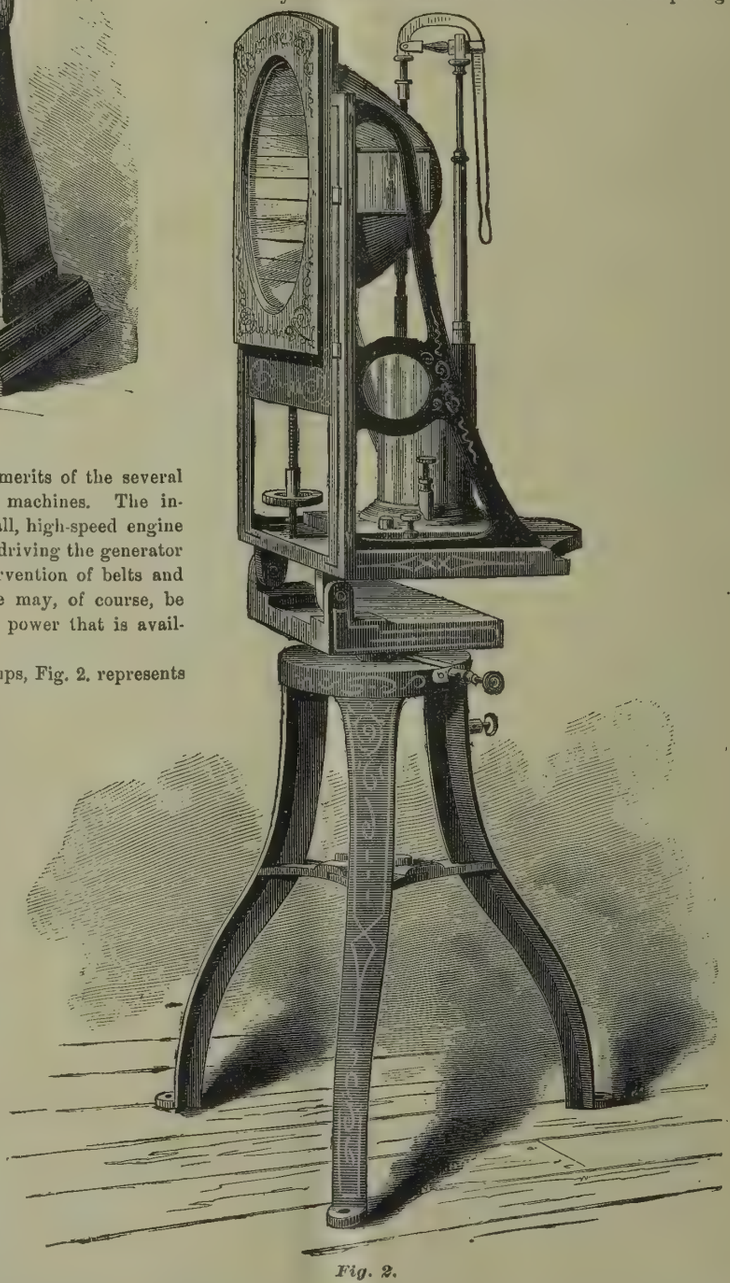


Fig. 2.

illuminate only distant objects, a funnel-shaped bonnet is attached to the front of the lamp, thus cutting off all light but that emanating from the center of the lamp. It is affirmed that either of these lamps will throw a beam of light strong enough to read by at a distance of five miles on a clear night, and many hundred feet in a dense fog.

The whole apparatus, generator and lamp, seems to possess every requisite and desirable quality for the purpose for which it has been devised, and we feel sufficient interest in the subject of the employment of electric lights on shipboard, to reiterate our previously expressed opinion that in one form or another its use should be insisted on for the prevention of collisions and other disasters that their employment would almost certainly prevent.

Further information respecting this apparatus may be had of the United States Electric Lighting Company, 120 Broadway, New York.

Statistics of American Railroads.

The thirteenth annual volume of "Poor's Manual of Railroads of the United States" has just appeared, and, as usual, gives an interesting and instructive history of the progress and condition of our transportation companies. We give below a *resumé* of some of the more important statistical facts and figures which the volume affords, with the statement that they refer to the year 1879.

It appears that during the year just past, the railroads of the country were very prosperous. Their earnings were larger than ever before, and the number of miles of new road added was greater than for any year since 1873. Mr. Poor places the total mileage of American railroads in 1879, at 86,497; and the gross earnings of all the roads whose operations have been reported, is placed at $529,012,999, as compared with $490,103,351 for 1878. In connection with this increase in earnings, a marked feature has been the steady reduction of freight charges, during the past few years, by the leading roads. To continue this policy, an immense increase in tonnage will be necessary.

The facts respecting tonnage are as follows: In the year 1873, which was the year of greatest prosperity for our railroads prior to 1879, the thirteen leading railroads carried 45,557,002 tons of freight, and received therefor $112,004,648, an average of 1.77 cents per ton per mile. In 1879, these roads moved 67,092,549 tons, and received therefor $116,311,452, an average of 1.02 cents per ton per mile. The increase of tonnage of 1879 over that of 1873, was, by these figures, 47.27 per cent; and the increase of earnings from that source was only 3.84 per cent. Freight rates have decreased 42.31 per cent, or nearly as much as freight traffic has increased; and it is noticed as an indication of economical management, that the rate per mile at which freight is now carried with profit, would have been considered impossible five years ago.

Notwithstanding the fact that the railroads in 1879 managed to reduce their floating and funded indebtedness by $40,619,355, the amount of interest paid shows an increase over the preceding year of $9,077,006; to offset this, however, the fact should be mentioned that capital stocks were increased by $187,708,068. To summarize, it appears that while the gross earnings as compared with 1878 increased $38,909,648, and the net earnings increased $32,341,557, the amount paid for interest and dividends only increased $17,129,106. The remainder has gone into permanent improvements, reserve funds, and other forms of security.

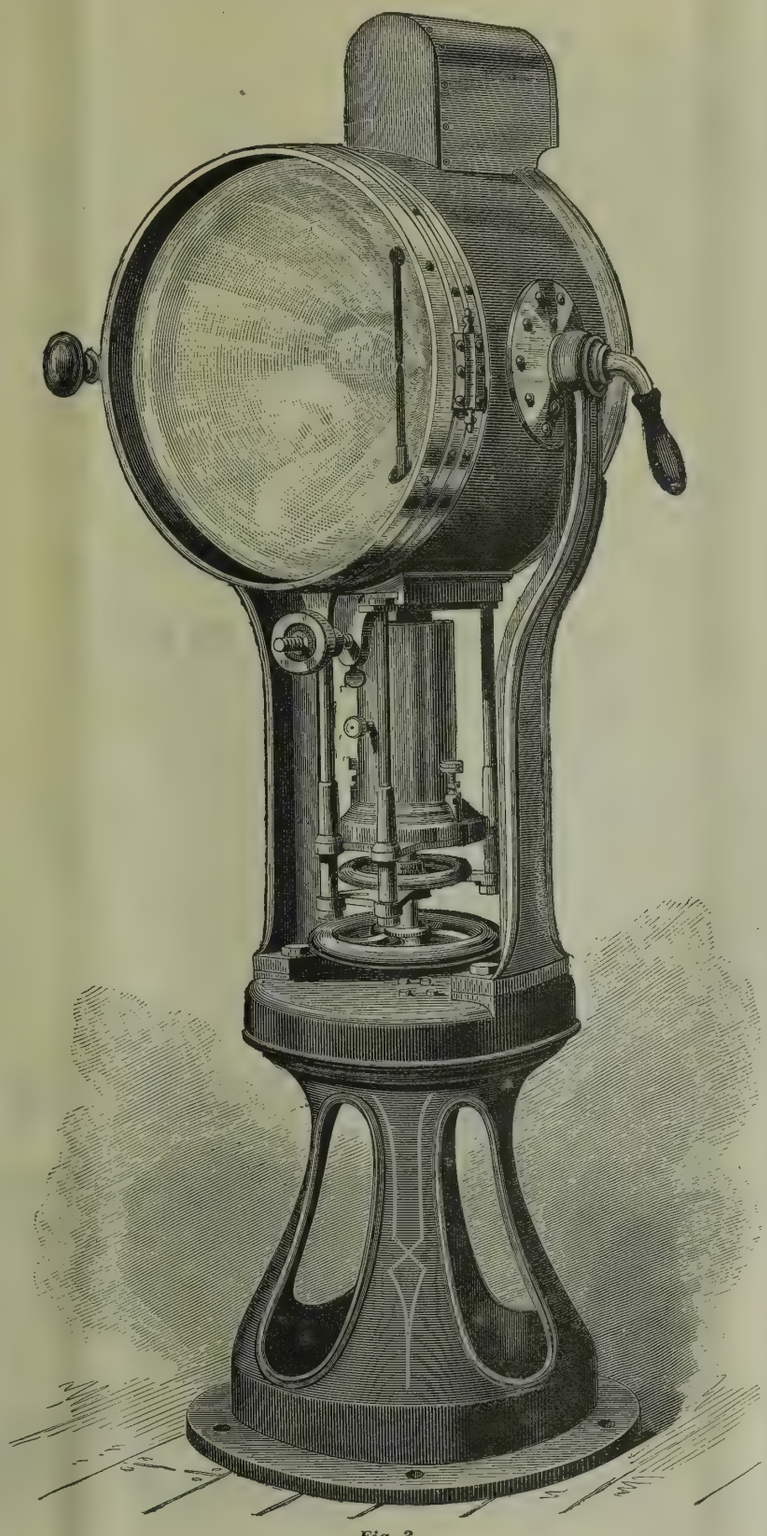


Fig. 3.

Classifying the States by their geographical position, the gross earnings for the New England States were $41,329,825, against $41,260,203 for 1878, and $44,590,465 for 1877. Of these earnings, $23,807,143 were received for transportation of freight, mails, etc., and $17,522,682 for the transportation of passengers. The net earnings were $15,586,091, against $13,685,927 for 1878, and $13,735,746 for 1877. The dividends were $7,236,205 against $7,566,655 for 1878, and $6,977,726 for 1877. The gross earnings of the railroads in the Middle States were $170,310,846, against $155,458,968 for 1878, and $155,943,121 for 1877. Of gross earnings, $127,115,208 were received for transportation of freight, mails, etc., and $43,195,638 for transportation of passengers. The net earnings were $70,416,970, against $61,559,993 for 1878, and $61,033,089 for 1877. The dividends paid amounted to $24,335,164, against $21,148,442 for 1878, and $24,890,480 for 1877.

The gross earnings of the railroads in the Southern States were $43,917,284, against $42,797,284 for 1878, and $39,812,358 for 1877. The net earnings were $14,673,357, against $14,379,958 for 1878, and $12,664,346 for 1877. The dividends paid amounted to $2,131,770, against $2,805,799 for 1878, and $2,740,793 for 1877. The earnings from freight, mails, etc., were $32,595,806, and from passengers $11,321,478.

The gross earnings of the railroads of the Western States were $232,379,646, against $209,852,375 for 1878, and $193,204,516 for 1877. The net earnings were $98,961,906, against $77,958,229 for 1878, and $66,085,243 for 1877. The dividends paid amounted to $23,561,262, against $19,341,222 for 1878, and $14,556,462 for 1877. The earnings from freight, mails, etc., were $77,930,875, and from passengers $54,448,771.

Nickel Bronze.

A French company, La Société Française Anonyme de Nickel, is endeavoring to supersede the nickel-plating of brass and copper by the use of solid nickel bronze, which is thus obtained: The ore, *garnierite*, extensive deposits of which exist in New Caledonia, the French penal settlement, is worked by Messrs. John Higginson & Co., of Nouméa. It is by them subjected to a roasting or preliminary fusion, which forms a regulus, containing from 60 to 70 per cent of metallic nickel. This substance is shipped to the works of the French company, at Septèmes, near Marseilles, where it is smelted into ingots and granules containing 99½ per cent of pure nickel and ½ per cent of utilizable metallic substances. The extent of the mineral deposits in New Caledonia, the reduction in the cost of freight owing to the concentration of metal through the preliminary fusion, and the economy effected by the new methods of reduction devised by M. Jules Garnier, enable the company to sell the pure metal at about one-half the price it obtained three years ago. For a long time past efforts have been made to work nickel, but without success, until about a year or so ago, because it was found too brittle; now, however, pure nickel has been rolled and forged—cups, knives and other articles having been formed of it. As a rule, the pure nickel is mixed by the founder with various proportions of copper, zinc and tin, according to circumstances, to form nickel bronze; but at least 20 per cent of nickel is required to secure protection against the action of the atmosphere, and to give the desired tint. All articles, according to the *Journal of the Society of Arts*, that are now made of brass or copper nickelized may be produced in solid white nickel bronze.

Cushing's Safety Hydro-Pneumatic Elevator.

We illustrate and describe in what follows, a system of hoisting machinery known as the Johnson & Bailey system, which appears to combine to an eminent degree the qualities of safety with speed and economy. The system in question, as will be observed further on, is hydro-pneumatic—in other words, compressed air and water are used, the former being employed to do the lifting, while the water is relied upon to give steadiness to the movement of the car in ascending or descending. As elevator accidents are still by no means as rare as they should be, in spite of the amount of inventive talent that has been of late years devoted to the perfection of this class of machinery, our readers will be interested in perusing the following description of an apparatus which embodies some really valuable improvements.

The ordinary hydraulic elevators are provided with a tank of some size, which is located at the top of the building, and another in the cellar, the water being pumped from the cellar to the upper tank, and flowing thence to the hydraulic engine, the hight of the water column so obtained giving the pressure used to lift the car and its load. No provision is made in this type of apparatus to regulate the pressure according to the load to be lifted, as the hight of the column and its pressure remains uniform, whether the load be heavy or light; consequently, as much work is expended in the one case where it is necessary as in another where it is not.

In the Johnson & Bailey system, all the advantages of the hydraulic system are retained, and this defect is simply and effectively remedied. The tanks are located near to the hydraulic engine in the cellar of the building. The hydraulic engine E, Fig. 1, usually bolted to the underside of the floor above the cellar, and the tanks directly under it. The tanks are shown in the accompanying illustration in the form of a horizontal cylindrical vessel, resembling a boiler, containing a division head which forms two compartments, one C for the water, and the other B for the air. The water tank C contains a little more than enough water to fill the engine cylinder, and the air reservoir is of sufficient capacity to supply the required amount of air for several complete trips of the car fully loaded, and is provided with a safety-valve G to prevent excessive pressure. The tanks are made of the best material, and are tested to insure their strength and safety.

The hydraulic engine consists of a cylinder, with a piston of proper diameter and stroke for the work to be done, a frame for supporting the sheaves, and guides for the traveling head. The multiplying gearing H is similar to a huge pair of blocks, and consists, according to circumstances, of six, eight, ten or more sheaves, each sheave being nicely turned and fitted for two wire ropes, and each rope will safely hold about ten times the weight it is calculated to hoist. With a ten-sheave engine of course the car travels ten times the distance in the same, or equal time, that the piston of the engine travels. This form of hydraulic engine is used because theory and practice both prove that there is

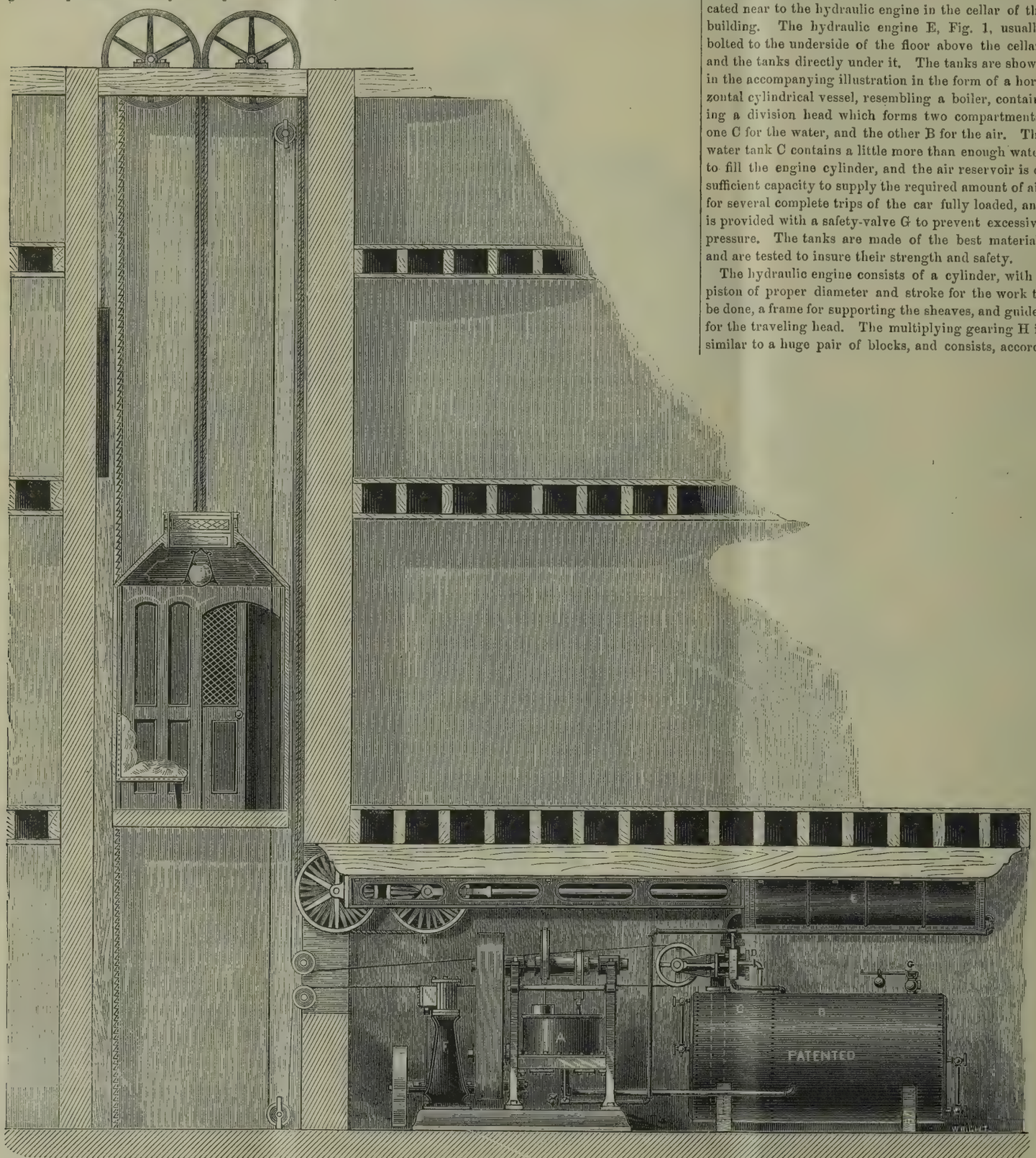


Fig. 1.—NEW SAFETY HYDRO-PNEUMATIC ELEVATOR.

much less loss from friction than when the piston travels half the length of the travel of the car, or when any form of toothed gearing is used; it also occupies less room in the building, and that generally of little value.

The air is compressed by a compressor A, which was designed especially for this elevator, there being no compressor in the market that would fulfill the conditions necessary for this work economically and without objectionable noise. The compressor can be driven by a belt from a line of shafting when there is power in the building, or when power can be hired from a neighboring building; or it can be driven by an engine F upon the same bed with it. The air is compressed up to 60 pounds, or more, per square inch above the atmosphere in the reservoir B. From the reservoir, as it is wanted, the air passes to the top of the water tank C; the pressure of the air upon the surface of the water in the tank forces the water out of the tank, through the pipes and valves D, into the engine cylinder E and against the piston; when the pressure against the piston exceeds the amount necessary to overcome the friction of the machinery and the weight of the load in the car, the piston moves and the car is raised. Between the air reservoir B, and the water tank C, there is an automatic regulating valve, which has the pressure of the air in the reservoir upon one side of it, and the pressure upon the piston, due to the load in the car, upon the other side of it; the difference in these pressures opens the valve enough to allow a sufficient amount of air to pass to the water tank to overcome the resistance offered by the load in the car, and no more; by this means a light pressure is supplied for a light load and a heavy pressure for a heavy load; the action is automatic, and the result very economical.

Another economical feature is this: When the operator in the car pulls the cord to descend, the air supply valve is shut, the water valve opened, and the exhaust valve opened; the air which has just been used to lift the load is exhausted from the top of the water tank C into a pipe that leads directly to the suction of the air compressor A, and also to the back end of the engine cylinder E. As soon as the pressure upon the front and back side of the engine piston is equalized, which is almost instantly, the weight of the load in the car causes it to descend as fast as the water is permitted to be transferred from the engine cylinder through the main or water valve into the water tank, and the speed is entirely under the control of the operator in the car, who can open or close the valve, more or less, at will. At the same time, while the car is coming down, the compressor A is pumping the air, which has just been exhausted, back into the air reservoir B again, and, instead of pumping free air of 14.7 pounds absolute or atmospheric pressure, the air is returned to the compressor at a pressure which will depend upon the weight of the load just hoisted, and may be 40 or 60 pounds absolute pressure in the beginning, which will gradually be reduced by the pumping of the compressor until it falls enough below the atmospheric pressure to allow the suction check valve to open, and free air is taken in. By this arrangement, the same air is used over and over again, the slight leakages, if any, being made up by the compressor from free air, when necessary; the theoretical losses due to air compression are reduced to the lowest practical limits, and a smaller air compressor can be used than would be necessary to pump the required quantity of free air.

The guide posts for the car extend throughout the whole hight of the building, from the cellar to the roof, and are faced with safety ratchets, between which the safety car platform is raised and lowered by means of the two wire lifting ropes which are connected with the hydraulic engine. The car platform is moved at any speed desired by the operator, and when stopped, is held rigidly in place by the water between the piston and the valve. The valves are balanced and tight. The car platform (Fig. 2) is fitted with safety locking pawls, combined with a powerful steel spring, and the simplest possible device for forcing the safety pawls into contact with the safety ratchets should the lifting ropes break. These have been used for many years, have proved perfectly reliable, and can be depended upon to reduce the fall possible to the car to the length of the ratchet tooth.

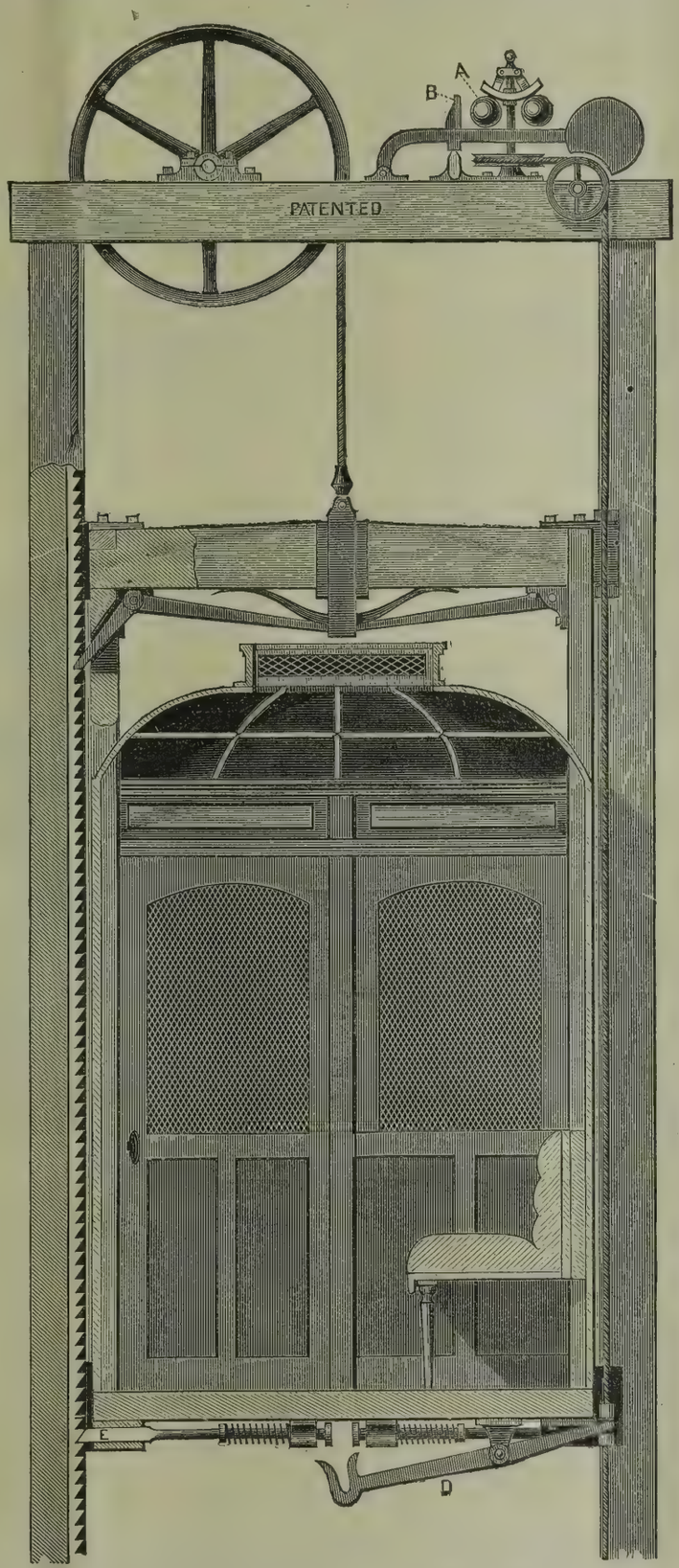


Fig. 2.—SAFETY DEVICE FOR ELEVATOR CAR.

Besides the ordinary safety pawls attached to the lifting ropes, there is an extra set of patent safety pawls E underneath the platform of the car, which are operated by a separate wire safety rope; this rope is a safety device entirely disconnected from any of the other working parts of the apparatus, and extends from the top to the bottom of the hoistway, running over pulleys at the top and bottom, and both ends are connected to the lever D (see Fig. 2), which operates the safety pawls under the car. The safety rope travels with and at the same speed as the car. In the upper part of the hoistway the rope passes over pulleys which give motion to a safety hammer or brake A. When the car is running at its ordinary speed, the safety hammer does not act; but as soon as the speed is accelerated beyond what it should be, the balls A fly out and strike the catch-plate B, the brake is dropped, and the motion of the safety rope ceases, while the motion of the car is continued far enough to throw the safety pawls or dogs E into the safety ratchets, and the car stops instantly. In addition to the above-mentioned safety devices, there is also an automatic stop upon the hydraulic engine, so that if the check rope should break, and the operator lose control of the car, the engine will stop itself when the car arrives at the top or bottom of its run.

The manufacturer claims for this apparatus, that every kind of accident that has been known to occur during many years of experience, or that can be imagined, has been provided for and guarded against, and that there are no better or simpler safety devices in use to-day than are supplied with these elevators. It is further claimed that the apparatus has certain special advantages over others, the most important of which are that the amount of pressure needed to raise a given load is automatically regulated, thus insuring the greatest possible economy in doing its work; that any amount of pressure, within reasonable limits, can be obtained in an emergency to raise special loads; that the movement of the car is free from jerks and oscillations; that it obviates the necessity of heavy tanks of water to be supported on the roof of the building, and of pipes running through the building to freeze and leak, and cause trouble in other ways; that the mechanism is simple and strong, not liable to get out of order; that it is economical in running; and finally, that it can be run faster with perfect safety than any other form of elevator.

For further information, address N. B. Cushing, foot of Morris street, Jersey City, N. J.

Icebergs.—Some icebergs attain a prodigious size. Dr. Hayes measured one which had stranded off the harbor of Tessuissik, to the north of Melville Bay, and estimated it to contain about 27,000,000,000 cubical

feet. This iceberg could not have weighed less than 2,000,000,000 tons; it was grounded in water nearly half a mile in depth. What, then, must have been the thickness of the glacier from which it had been detached? Captain Ross, in his first voyage, describes another iceberg of gigantic proportions. This mass of congelation had stranded in 61 fathoms of water, and its weight was estimated at 1,202,307,063 tons.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

NEW YORK CITY BUILDING ITEMS.

A four-story brick public school-building, 50x87 feet, to cost about $80,000, is to be erected at Nos. 21, 23, 25 and 27 Norfolk street. Architect, D. J. Stagg.

An extra story is being added to the Metropolitan Hotel, for the A. T. Stewart estate. Mr. Harris is the architect. The alteration is expected to cost $30,000.

An extensive addition, covering about 72x30 feet, is to be made to the Trinity Building, on Varick street. It will be four stories high, of brick and stone, will contain a chapel, and cost about $30,000. Chas. C. Haight architect.

James Renwick, architect, has filed specifications for the proposed alterations of the Stock Exchange. The present building at Nos. 14 Broad and 11, 13 and 15 New streets, will be raised by the addition of four stories, giving a hight of 85 feet for walls, with a Mansard roof 120 feet high in front. The plans also include an extension of 24x67x153 feet, and five stories in hight. The alterations are to cost about $230,000. The New York Stock Exchange is the building company; Samuel Lowden, mason, and Edward Gridley, carpenter.

A white marble dwelling for Cardinal McCloskey is to be built on the northwest corner of Fiftieth street and Madison avenue, in the rear of the cathedral. It will be 64 by 54 feet, four stories high and basement, and, in harmony with the cathedral, will be in the Gothic style. The entrance on Madison avenue will be a porch, flanked with buttresses and pinnacles, surmounted by gables; the jambs of the windows will be molded in simple designs. The estimated cost is about $80,000. James Renwick is the architect.

The Grand Hall of the Masonic Temple, Twenty-third street and Sixth avenue, has been leased to Paul Primier, who will open it about the first of this month, purposing to permanently establish a place of refined amusement, catering especially to ladies and children. Extensive alterations have been made, the floor of the auditorium being raised and re-seated, so that a good view can be obtained from all seats, a considerable sacrifice in number being required.

The corner-stone of the new Roman Catholic church, to be known as St. Leo, in Twenty-eighth street, between Fifth and Madison avenues, was laid last month. The building, with the ground, will cost over $90,000. The building will be in the Corinthian style of architecture. It will be 50 feet front, 120 feet deep, and 56 feet from the floor to the ceiling. The front will be of Belleville stone, and the trimmings of marble. In the center of the structure will be a large cross, rising 74 feet above the street. The church will have so nearly reached completion in October, as to permit of services being held in it, and it is expected that it will be completely finished by the end of the year.

The Mission of the Immaculate Virgin, at the corner of Lafayette Place and Great Jones street, of which we have in a previous number made brief mention, is now rapidly approaching completion. The building is of very handsome design, and of a highly substantial character. It is, besides, fire-proof, and possesses every modern convenience, while the heating, lighting and ventilating arrangements are as perfect as the latest teachings in sanitary science could make them. We are indebted to the Rev. Mr. Drumgoole for the following additional details in relation to the building: The external length is 120 feet; width, 78 feet; and the hight, from sidewalk to top of roof, 126 feet. There are eight stories, exclusive of basement and attic. The walls are thoroughly constructed of brick and cement, the fronts of Philadelphia molded brick, and the basement of blue stone. All moldings of terra-cotta, and string courses also, the only stone used above the basement being for sills and lintels of upper windows, which are of Wyoming stone. The roof is of iron, with fire-proof arches between, and slated on the street fronts. The basement contains a restaurant, kitchen, spare room, private bath-room, and the entrance for boys. The first floor contains publication rooms, chapel, with accommodations for 500 persons, vestry, guest room, etc. On the second floor are apartments, study class-rooms, reading-room and library. The dormitories are on the third, fourth, fifth, sixth and seventh floors. A court, reaching from celler to roof, around which the corridors and principal approaches are arranged, runs through the center of the building, varying from 34x15 feet at base to 53x16 feet at summit. The attic floor contains a laundry and play-room for the boys. The stairways are fire-proof; one flight is constructed of brick and slate, the other of iron, with slate steps. There is no connection between the sewers and the interior of the house. The water-closets are confined to a separate structure, erected for that purpose in the open court that separates the two wings of the house, and which we have already referred to above. Access is afforded to this structure from each floor of the house by suitable passageways, and, in this way, the house will be protected from unhealthy gases, which, in buildings of this kind, would be likely to cause disease. The estimated cost of erection will not fall short of $160,000. This is apart from the sum of $70,000 (in round numbers) already paid for the site. The architect is L. J. O'Connor, of 111 Broadway.

The additions and improvements to the Cooper Union, upon which workmen have been engaged for several months, have been practically completed. The finishing part of the work was the putting up of a new double elevator at the Fourth avenue and Seventh street corner of the building. The large hall of the Union has been kalsomined anew, and painted. The color of the backs of the seats has been changed from green to a light orange, and the cushions have been repainted and varnished. New chandeliers have been placed in the hall. The effect of these improvements has been to make the hall appear much brighter and more attractive. In the committee room, at the side of the hall, an additional wall has been built upon the street side for the purpose of preventing dampness. The additions to the building are finished. They consist of a large room at the southern end of the building, two stories in hight, and reaching from Third to Fourth avenues; and of a long double apartment, also two stories high, extending along Third avenue to Eighth street. The additions have been built by Peter Cooper at an expense of about $50,000. It is the intention of Mr. Cooper to devote the additional stories to the evening schools of the Art Department, and for this purpose the rooms have been constructed with high ceilings and plenty of light. The new room at the southern end of the building, constituting the eighth story of the Union, is 104 feet long by 18 feet wide. It has six large windows on Fourth avenue, and at the opposite end opens into the rooms along Third avenue. These rooms together measure about 160 feet in length, and open into each other by two large brick arches. The dimensions of the first are 90 by 36 feet, and of the other, which faces partly on Eighth street, 60 by 40 feet. There are seventeen windows in this corner room, and nineteen in the other. The size of the room on Third avenue and Eighth street is 40 by 25 feet, and has twelve windows. The windows are all high and wide, and make the rooms very light. The ceilings are finished with designs partly circular and partly to resemble columns. The doors leading to these apartments are wide, and made of plate glass. The floors are carefully laid, and consist of narrow strips of yellow pine thoroughly oiled. Above this story are the new dome and ninth story of the building. The room in the dome is 35 by 25 feet in size. The dome itself is of iron, and its top is 50 feet from the floor of the room, and 150 feet from the street. A narrow ornamental gallery surrounds the inside of the bottom of the dome, the floor of which is a tasteful combination of ash and walnut, containing in the center of each block a star and other designs of inlaid work. The view from the dome is very extensive, and many visitors have already enjoyed it. The roof of the addition is of tin, covered with two thicknesses of asphalt. A neat iron railing surrounds the edge. A large clock with four dials in the building has been put in the southern side of the dome at a cost of $1,500. The additions to the building will enable probably between 700 and 800 more pupils to be accommodated. The young men of the Art Department will be transferred to the new rooms, and the old apartments on the fourth floor will be given up exclusively to the young women of the school. One of the improvements made in the Art Department is the introduction of a new and better system of ventilation. Two hundred feet of linen hose have been placed on each floor of the building, connected with the water pipes and a large steam pump capable of throwing water 75 feet.

MISCELLANEOUS.

Danbury, Conn., has appropriated $20,000 for a new school-house.

Bridgeport, Conn., is to erect a school-building at a cost of $55,000.

Wing's Opera House at Helena, Montana Territory, will cost $23,000.

The German and French Catholics of Meriden, Conn., are to build a new church.

The old City Hall, at Albany, N. Y., is to be replaced by one which is to cost about $200,000.

A glucose factory, for which $500,000 have been subscribed, is to be built at Ithaca, N. Y.

The Nordyke & Marmon Company are building a 300,000-bushel elevator for Brown & Boyd, at Indianapolis, Ind.

Kidder, Peabody & Co. have purchased a lot of land on Sewall Place, Boston, upon which they propose to build a large and costly banking-house for their own use.

The trustees of Bay View Asylum are about to erect a building for the insane of Baltimore, Md., $50,000 having been appropriated for the purpose. Frank E. Davis has been appointed architect.

Steinway & Sons, of New York, have contracted with Boynton & Wheeler to build them a new shop, 120 by 60 feet, and three stories high, at Leominster, Mass. This contract will require 216,000 feet of lumber.

The First Congregational society, of Turner's Falls, Mass., have a fund of $5,000, and advertise for bids for a new church building of wood, with stone and brick foundation. It is proposed to get the building covered before winter.

F. Denmead, owner of the City Malt House, at the intersection of West Falls avenue and Block street, Baltimore, Md., is building a large six-story addition to said building. The new building, with machinery, will cost from $50,000 to $60,000.

The plans of E. T. Mix have been accepted for the exposition building of Milwaukee. He agrees to give the building careful attention succeeding the preparation of the drawings, at a charge of 3.5 per cent of the cost of erection. Work will commence immediately, and will be vigorously pushed. The building will cost from $150,000 to $200,000.

There are being erected in Buffalo, N. Y., the following buildings: a seven-story office building, for James P. White, to cost $175,000; alterations and additions to old Unitarian church, to cost $36,000; an edifice for the Prospect Avenue Baptist church, to cost $30,000; Marine Bank, to cost $25,000; a malt house for Wm. W. Sloan, to cost $19,000.

The Kropff Ice and Refrigerating Machine.

For the artificial production of ice, or of cold air or water, the great majority of machines in use in industrial establishments are ammonia machines. For this fact several reasons may be assigned, the most weighty of which are that ammonia is cheap and readily obtainable, and that the ammonia machines (special reference being had to machines operated on the absorption principle) are not wasteful of power. Among manufacturers of ammonia absorption machines, Oscar Kropff, of Nordhausen am Harz, in Germany, has attained an extended reputation by reason of excellence of design and construction, and special adaptation to the requirements of large breweries and the like.

We give in the accompanying engraving an illustration of the Kropff ice machine, with water and air cooling attachments. The principles governing the action of this machine will be understood from the following description: The supersaturated ammonia water is heated in the cylindrical chamber (or boiler) A, by means of steam; the ammoniacal vapor is forced under pressure through condensing coils, where the vapor is condensed, and the liquid ammonia collected in small vessels in front of the absorber B. From these vessels the ammonia is conducted by means of a system of small tubes to the ice-making tanks C C, and the refrigerating tank D of the air-cooler. By the rapid evaporation of the ammonia in the coils of the tank, and in that of the refrigerating tank of the air-cooler, sufficient heat is abstracted from the surroundings to produce ice in the former and intensely cold brine in the latter. The ammonia vapor is then conducted back to the absorption cylinders B, where it is brought into contact with water from the boiler, by which it is absorbed, and then pumped back into the boiler.

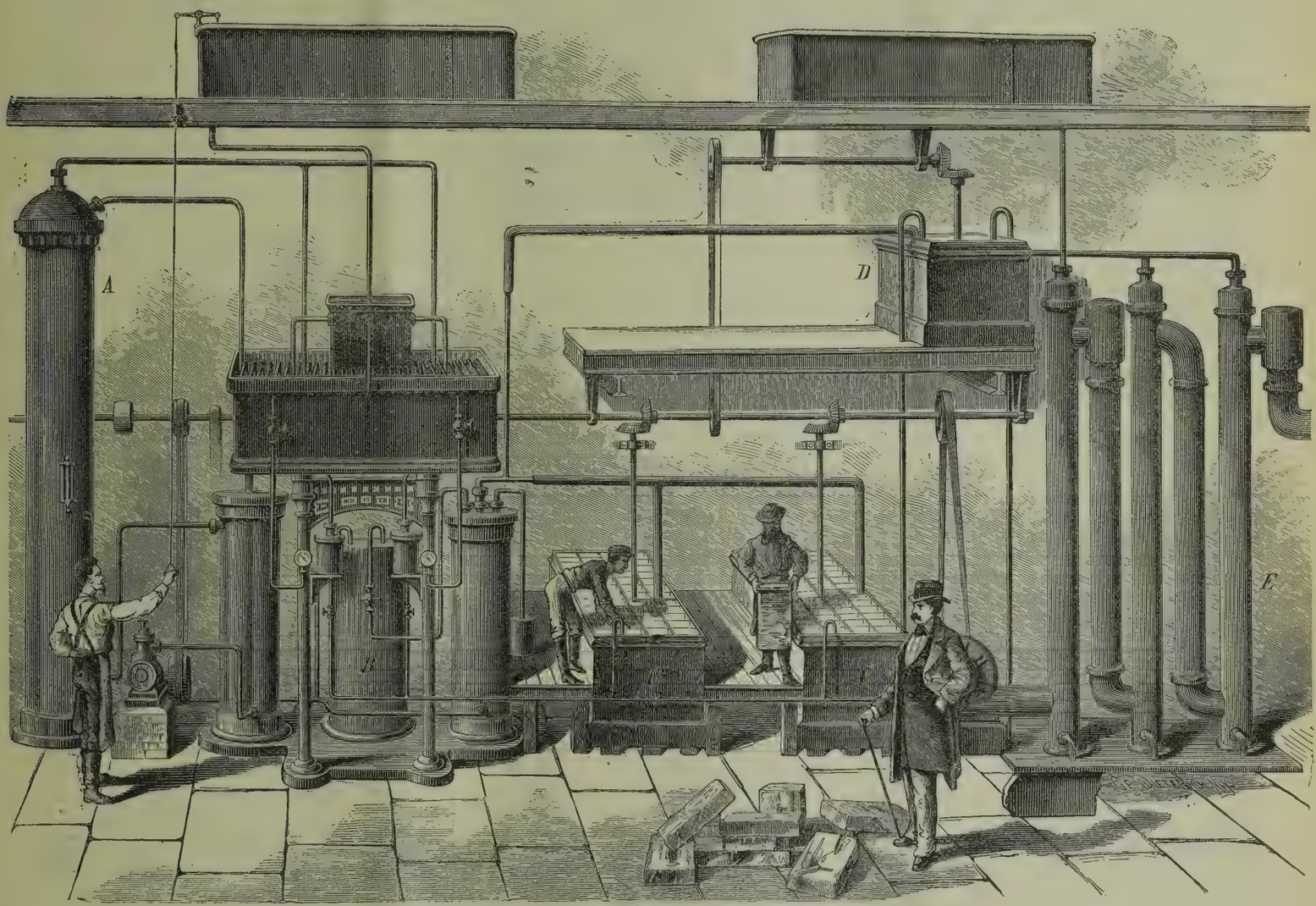
The ice is made in cans of any desired dimensions, and is taken out from time to time and stored in the ice-house. The cold brine of the refrigerating tank D may either be used directly for cooling the decoction of malt and hops as it passes over the wort coolers, or for cooling the liquid in the fermenting tubs themselves, or for cooling the air with which the fermenting rooms, vaults, etc., are supplied.

The air-cooling portion of the machine, which is practically a separate device, consists of a system of upright cylinders E, into which the air is forced by means of the fan-blower shown in the engraving. The air, entering near the base of the first cylinder, passes upwards, then down the connecting arm into the base of the second cylinder, and so on through the connected series. The cylinders are provided at the top with perforated plates, through which water or brine previously refrigerated by the machine, is allowed to descend in a fine spray, and by contact with which, on its passage in the opposite direction, the air is thoroughly chilled by the abstraction of its heat. The cold brine is collected in a vessel beneath the cylinders and pumped back again into the refrigerating tank D, to be used again with the least possible loss of cold; and the chilled air is conducted away through flues, provided with suitable openings through which it is distributed and admitted into the cellars, vaults, etc., that it is intended to keep cooled.

In the first cylinder the entering air is designed to be moderately cooled by means of a spray of spring water, to prepare it for the severe chilling it receives from the brine which it encounters in the other cylinders. This plan is obviously an economical one, and to effect it, the first cooler is connected with an overhead tank of spring-water, and the others with the refrigerated brine tank D. It is almost needless to add, that by the use of a brine, a much lower temperature can be reached before freezing will ensue than with pure water, so that, for example, by employing brine in the refrigerating tank, a temperature as low as 24° or 25° Fah. can be attained without freezing, while with pure water 33° to 34° would be approximately as low as it could be cooled in practice. It is manifest, therefore, that whether the refrigerated brine is used directly for cooling the wort, or for chilling air, its cooling powers are correspondingly greater.

This machine is, therefore, adapted for providing either ice, cold water or cold air, either separately or simultaneously, as may be required; and from its great simplicity, and its special features, it seems to be admirably adapted for the needs of the brewery and for other industrial uses, since it affords the manufacturer its equivalent of cold in any form in which he may desire it. These machines are built of several sizes, with a capacity of from 200 pounds to 1 ton of ice per hour. They have been extensively introduced in Germany in many of the leading breweries.

The representative of the manufacturer in this country is Mr. Paul Goepel, Tryon Row, New York, from whom further particulars may be obtained on application.



KROPFF'S ICE AND REFRIGERATING MACHINE.

Electrotyping with Iron.—Herr Bottger describes a process for steeling copper plates by electrolysis. One hundred parts of ferrous-ammonia sulphate, together with 50 parts of sal-ammoniac, are dissolved in 500 parts of pure water, a few drops of sulphuric acid being added to acidulate the solution. The copper plate is connected to the negative pole of a battery of 2 or 3 Bunsen elements, an iron plate of equal size being employed as an anode. The solution is maintained at 60° to 80°. The deposit of iron is of a hard, steel-like quality.

An Imposition on Providence.

An ancient superstition that still possesses some vitality, attributes sickness, disease and other misfortunes of mankind, to the interposition of some supernatural power. Among the lowest savage tribes this superstition takes the very gross form of a belief that the person afflicted has been bewitched by an enemy, and unless a member of the tribe dies of a wound, he is believed to have been the victim of sorcery. The prevalence of this belief among the negro tribes of Africa is responsible for the most frightful sacrifices of human life. Superstitious notions similar to these are recorded as entering into the beliefs and practices of many barbarous races of men. The Greeks and Romans held the notion that the good and evil fortunes of men were directly presided over by the deities, and in seasons of public calamity or private disaster, sought, by means of sacrifices and offerings, to appease the anger of their gods. The Mohammedan mutters "kismet," and stoically accepts disaster and disease as the will of Allah. And, singular as it may appear, the leaders of theological opinion among the so-called Christian nations, have, up to the present time, been unwilling, or unable, to refine their creeds by the elimination of misconceptions equally gross and childish as these. In the belief to which the orthodox Christian is required to make confession, there is still embodied, if not literally expressed, the ancient superstition that such occurrences as a comet, eclipse, drought, flood, storm, famine, pestilence, earthquake and the like, are the evidences of the direct intervention of a supernatural power, and the means which God employs to manifest His anger or displeasure at the sins and shortcomings of His creatures.

As men in time applied their minds to the study of nature, it came gradually to be understood that all these things occur in strict accordance with natural laws—that they were the natural and inevitable consequences of certain antecedents, and that in every case where the antecedents were known, the consequences could be predicted with certainty; and long ago, among scientific thinkers, conceptions of law, order and uniformity took the place of the ancient notion of interference from without in the operations of nature. From being at first confined to a few bold thinkers much in advance of their times, the scientific view of the course of nature has in our day spread so widely, that it may be said without fear of contradiction, to have substantially eradicated the theological assumption of supernatural interference in the affairs of man and nature from the minds of thinking people of all classes. So manifestly is it at variance with the knowledge and spirit of the times, that the cold and nominal assent with which it is received by the rigid adherents of the orthodox Christian sects to-day, serves mainly to bring into significant and instructive contrast the fervid and aggressive faith in the doctrine of supernatural interference, that characterized the Middle Ages.

In no direction has the recent progress of science been more decided than in the study and comprehension of the origin and nature of diseases, and in the methods of successfully combating and preventing them. And especially is this statement true of a number of the most virulent diseases with which mankind have for ages been afflicted. The particular diseases here referred to, are what are specifically described as "zymotic," a term which indicates an epidemic or contagious disease, whose origin is ascribable to some morbific principle introduced from without—a living germ, which, by its introduction and growth and development within the human organization, produces extensive functional derangements, and, in many cases, death.

In this category are classed such scourges of the human race as small-pox, cholera, diphtheria, malarial, typhoid and a number of other forms of epidemic fevers. In some of these, the specific nature of the disease-breeding germ has been detected in the microscope; in others it still remains to be identified; but in all of them the method of infection by the introduction of some specific virus from without, has been established beyond the possibility of doubt. Another point has been well established with respect to this class of diseases, namely, that the disease germ finds in accumulations of decomposing refuse—animal or vegetable—a favorable place for its development and propagation. Sanitary science has stepped in and shown us how such terrible afflictions may be banished, or, where they may have already obtained a foothold, how they may be checked and suppressed. With respect especially to typhoid fever and diphtheria, the commonest and most fatal scourges of civilized life, it has been so clearly demonstrated that they originate in accumulations of animal filth and refuse, that by common consent, they have been called "filth diseases." The cause being clearly understood, the methods of prevention are no less plainly indicated; and where they have been intelligently applied, these diseases have invariably been banished, or, where they had obtained a foothold, they have been eradicated. The preventive is simply cleanliness, as regards food and the air and water of our homes; and to gain exemption from these diseases, it is only necessary to provide adequate means for the prompt and efficient removal from the neighborhood of our dwellings of the decomposing and decomposable refuse and offal, that will otherwise become the nursery of disease germs, which, through the medium of the air or well-water, will in time poison their inhabitants. Even in the country, where the conditions for the propagation of this class of diseases are most unfavorable, local epidemics are not uncommon; and again and again have outbreaks in distant towns and cities been traced back to some such focus of contagion, the vehicle of transmission being sometimes milk drawn from the cow by an affected person, or watered from a well poisoned by the dejecta of a typhoid patient.

It is, however, in the towns and cities, where population is concentrated, that the disposition of their immense accumulations of refuse becomes a serious problem. The provisions for this purpose usually take the form of sewers, with which the gutters of the streets and drain pipes leading from the houses are connected. Where proper drainage systems of this kind have been introduced, the result has invariably been a decided diminution in the number of deaths from the causes we are here considering. Indeed, so uniform and obvious has been this improvement, that no sane person ventures to doubt that we have here a relation as of cause and effect. The consequence has been, that within recent times the question of the sanitary drainage of towns and cities is steadily attracting more and more attention from town and municipal authorities as a subject of supreme importance to the health of their inhabitants.

But while such attention to the sanitary care of our cities and towns has had most beneficent results in largely reducing the mortality from filth diseases, the knowledge that intelligent people have acquired, that such scourges are preventable and unnecessary, by the observance of a few simple laws of cleanliness, is even as great a victory, for it has robbed the unseen enemy of the terrors with which the superstitious fancies of earlier times had clothed him. There may be doubts as to the specific nature of this class of diseases, but we know enough about them now to assert with positiveness that their occurrence is a proof that the victim attacked has been poisoned by exhalations from putrefying organic matter; and, furthermore, that they die by the hand of man, poisoned to death by filth infection and by man's ignorance or neglect.

These preliminaries over, we come now to the real gist of our writing. Some weeks ago the newspaper-reading public were shocked to hear that an epidemic of typhoid fever had broken out at Princeton College—that a number of the students (eight) had died, and that as many more were lying seriously ill of the same disease. The outbreak pointed to but one possible cause—*defective drainage*, a fact which a subsequent investigation completely established, in showing that the soil pipes and wells for conveying and receiving the drainage of the college buildings had become choked up and ineffective. The exhalations from these, in time converted what should have been a wholesome, healthy dwelling-place, into a pest house charged with disease-breeding fever germs.

These facts having been shown to be what they are, it is interesting now to see what the authorities of that ancient seat of learning have to say about it. These men are chiefly responsible for this criminal neglect or ignorance of the essential laws of cleanliness, which are everywhere known and understood by intelligent people, and which, if understood and practiced anywhere, surely should be understood and practiced at a great educational institution, in which scientific training is claimed to hold an important place in its curriculum.

It might be supposed by the average reader gifted with common sense, that when Dr. McCosh, the President of this institution, felt himself called upon to make some allusion to the poisoning to death of eight young men of the college, and the sickening nigh unto death of as many more, he would have felt himself bound to say something like this: "We—meaning the college authorities—have been grossly careless of the health of the young men placed under our guardianship, in that we have permitted the college well to choke up and exhale the poison of disease among them. With shame and sorrow we acknowledge our responsibility for this most grave and terrible offense; but, having made this acknowledgement, we appeal to the fathers and mothers of these young men, and to the friends of the college generally, to temper the severity of their condemnation with leniency, for our offense was the offense of ignorance and not of intention, and we promise for the future to give the closest care and the most rigid oversight to the sanitary condition of the college buildings, that so terrible a calamity shall not occur again."

A manly, straightforward statement of the case like this, though it would not in any degree have lessened the responsibility of the authorities for the deaths of these promising young men, might have measurably condoned for their offense, and the intelligent public would have been disposed to throw the mantle of charity over their shortcomings and to judge them with leniency for their honest confession and promise of reform. But Dr. McCosh took a different view of the subject and of his responsibility. Referring to the subject during the public exercises of the last but very quiet commencement, he is reported to have said: "We owe it to the memory of those who have been taken away from us, to the feelings of their friends, to the sentiment prevailing in the community, to go through our duties in a subdued manner. The amiable and promising young men who have been removed from us will be remembered by their classmates all their lives. We all sympathize with their bereaved fathers and mothers sorrowing over the loss they have experienced, and many are praying for them that they be supported and comforted. We submit to the trial as a dispensation sent to chasten and to humble us."

Dr. McCosh, in brief, asks the intelligent public to believe that Providence is responsible for choked drain pipes and overflowing cesspools. He shirks the responsibility for himself and his associates, whose bounden duty it was to know the danger of neglecting these essentials to health, and to have seen that they were attended to, by a few smoothly worded expressions of sympathy, and then coolly throws the whole burden of his and their criminal neglect at the door of Providence!

Dr. McCosh insults the intelligence of the Nineteenth century by flaunting the rags of Middle Age superstition in the faces of his hearers. There may be a few among those who heard or afterwards read his remarks, so mentally befogged as to really believe that Providence had a hand in this matter. But Dr. McCosh and his associates know better than this. Fools and fanatics may believe such rubbish, but among the sorrowing fathers and mothers of the "amiable and promising young men" to whom Dr. McCosh so tenderly alludes,

there are many who are neither fools nor fanatics, and they will be disposed to look at the case differently. Some of them may be even wicked enough to wish that this "dispensation of Providence" had alighted on the authorities of the college who were responsible for the planning and condition of its drainage, instead of striking down the innocent victims of their ignorance or carelessness. This would, of course, have been a very regretable circumstance, but, from Dr. McCosh's standpoint, would at least have had in it the element of justice, which his creed teaches to be one of the distinguishing attributes of Providence.

But as many laws exist simply as a "dead letter" on the statute books, so, many dogmas and doctrines formerly held to be essential to the integrity of the Christian religion and to salvation, are nowadays, by reason of our better knowledge of the operations of nature, quietly suppressed. Or if some over-zealous parson, like Brother Jasper, with more faith than knowledge or discretion, still insists upon the revival of the childish beliefs of the unwashed Christians of the Dark Ages, among whom the frightful specter of the plague and the "black death" stalked unopposed, he is quietly coughed down or publicly ridiculed. But remove the thin film of varnish from the elegant phrases of Dr. McCosh's commencement address, and his conceptions are as gross and superstitious as those of his dusky fellow-laborer in the vineyard.

We feel it to be our duty to warn the fathers and mothers of other "amiable and promising young men," that so long as Dr. McCosh, and his associates (who presumably agree with him) entertain such notions of their responsibility for the lives of the students in their charge, as he has expressed, it is unsafe to send them there. The interests of society demand that he and his associates shall not thus lightly relieve themselves from responsibility for choked drains and overflowed wells, and throw it into the lap of Providence. The reckless mariner who deserts his post and runs his ship upon the rocks, or the guard who leaves the bridge-draw open to hurl a train to destruction, may with equal justice cast the responsibility for their "sins of omission and commission" upon Providence; but even professedly religious people will of one accord pronounce such an utterance to be rank blasphemy.

It used to be said of a certain State of the Union that it was a good place to emigrate from. We desire to say to fathers and mothers with sons ready for college, that until Dr. McCosh and his associates manifest a better appreciation of their duties and responsibilities, and a clearer understanding of the intelligence of the Nineteenth century, Princeton College is a good place to keep their sons away from.

How Long a Telegraph Cable Lasts.

The life of a submarine telegraph cable is from ten to twelve years. If a cable breaks in deep water after it is ten years of age, it cannot be lifted for repairs, as it will break of its own weight, and the cable companies are compelled to put aside a large reserve fund in order that they may be prepared to replace their cables every ten years. The action of the sea-water eats the iron wire completely away, and it crumbles into dust, while the core of the cable may be perfect. The breakages of cables are very costly, and it is a very difficult matter to repair them in comparison with land lines. A ship has to be chartered at an expense of $500 a day for two or three weeks in fixing the locality and in avoiding bad weather, as cables can only be repaired in the calmest seasons. One break alone in the Direct Company's cable cost $100,000 to repair, and the last chance left to the company was to make an agreement with the Anglo-American, so that they should be protected and have the use of that company's line when their own was stopped.

Railroad Extension in 1880.—Up to the end of July, there were 2,424 miles of new railroad built in the United States. This is more than double the new mileage added to our railroads for the same period of 1879.

Rotary Pumps.

The varieties of rotary pumps that have been devised are almost as numerous as those of reciprocating form. In some of them the cylinder revolves in a circular path, or rotates upon its own proper axis. The most common class of rotary pumps, however, is that

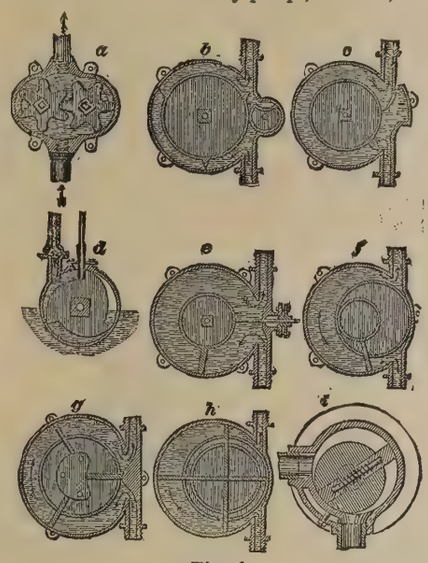


Fig. 1.

in which the piston or pistons rotate on an axis. A variety of modifications of pumps on this principle are shown in the accompanying illustrations, reproduced from "Knight's American Mechanical Dictionary,"

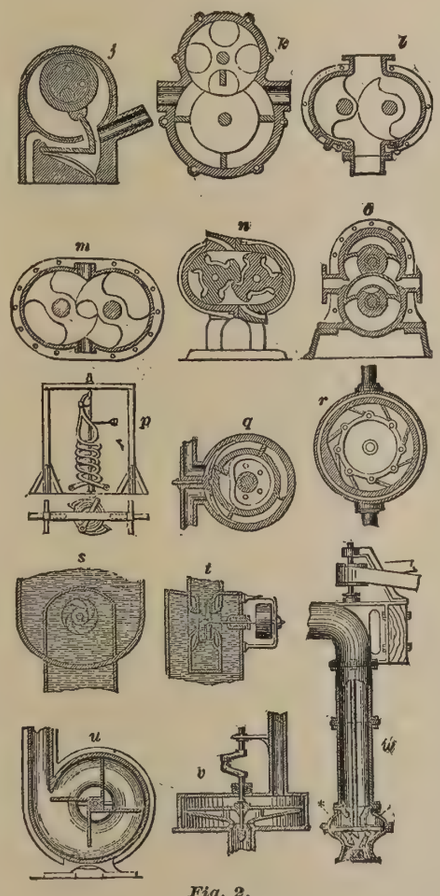


Fig. 2.

from which also we substantially excerpt the following descriptions:

In Fig. 1, *a* is a double-wheel pump, from the old collection of Sérviere. The cog-wheels rotate in contact with each other, the teeth of each filling the interdental spaces of the one opposite. This form of pump dates from the sixteenth century. *b* has three pistons on a hub and a rotating abutment, which offers a depression to enable the pistons to pass as they are successively presented. It is known as Eve's rotary pump. *c* has a hub with one piston, and a curved flap which turns on a hinge. In *d* the pistons are cam-shaped, and the vertical valve which forms the abutment, rises on the cam and then shuts down behind it, to rise again on the next cam. *e* has a sliding valve which is operated by exterior devices, and recedes to allow the piston to pass. *f* has two concentric drums, the annular space for the water being traversed by a piston, which consists of a rectangular piece of brass, driven by a revolving eccentric cylinder, which at the same time forms an abutment. *g* has three pistons, which move radially in a circular shell, which rotates in contact with the segment on the case, forming the abutment. A D-cam actuates the pistons. *h* has a rotary hub eccentric with the case, and two pairs of pistons acting in diametric slots. In *i* the hub is similarly placed, but has one pair of spring pistons in a single diametric slot.

In *j*, Fig. 2, the annular piston is moved eccentrically around inside the cylinder. The convex-faced valve is supported on a spring arm and follows the movement of the cylinder, so as to form a continued separation between the induction and eduction passages. *k* is known as Leuchtweiss' pump. It has four pistons, and an abutment wheel with four depressions, traversed by the pistons in turn. *l* is Andrews' pump, having a pair of segment-cams, each of which is a driver, and forms an abutment for the other. *m*, Hardy's pump, is an amplification of the same idea, the double-headed pistons revolving in two communicating segments of cylinders, and being geared together to secure uniformity of rotation. *n* shows Bazin's three-headed pistons, working in pairs, the head of one filling the depression of the other alternately. *o* is Behren's pump, with a pair of segments working on the same principle as *l*. *p* is Vialon's centripetal pump, the converse of the Barker mill. *q* is an old form of pump, with four pistons, which slip in and out radially, as they pass the abutment between the induction and eduction ports. The stationary eccentric allows them to be pressed in as they come against the incline, and again forces them out after passing the abutment. *r* has a number of hinged pistons arranged on the periphery of the hub. As each one approaches the double inclined plane forming the abutment, it is pushed in against the hub, and when it has passed the crest of the rise, is opened again by a spring beneath it. *s* and *t* are two views of the Appold rotary pump, which has a series of wings on a horizontal shaft revolving in the water. The views are vertical sections, taken in planes at right angles to each other. This pump has been largely used in England in wreckage and drainage. With a hollow cylinder 12 inches diameter by 3 inches deep, to which 800 revolutions per minute are given by a steam engine, this machine can raise 1,800 gallons of water per minute to the hight of 10 feet. Some remarkable results obtained with this pump in draining the Whittlesea Mere are recorded in "Knight's American Mechanical Dictionary," and also of Bessemer's pump, shown at *v*. *u* is the Massachusetts centrifugal pump. It has a short horizontal shaft, carrying a square boss, with four tangential blades, which rotate within a metallic case, having axial induction and tangential eduction. The pump is submerged, and is driven by gearing and shafting. *w* is Gericke's rotary pump. The vertical shaft carrying the wheel is driven by a band on a pulley above. Above the wheel is a series of curved guides to direct the water to the center of the chamber at the foot of the vertical stand-pipe. A fixed plate is placed above the wheel, and forms the door of the ascension chamber, the water being driven around its margin by the centrifugal power of the wheel.

Wood-Carving is an industry which is carried to considerable perfection among the Germans, and is fostered by the establishment of carving-schools, particularly in districts where the wood used for the work—Spanish walnut, the best walnut the Germans have—is plentiful. There are now eighty such schools in Germany.

American Locomotives.

From facts and figures brought together by Mr. Chanute, Vice-President of the American Society of Civil Engineers, and taken from the advance sheets of his annual address, it appears that American locomotives—which were already known to have at least as great speed as any in the world—can also pull greater trains and travel more miles in a year than any others. Early locomotives were not expected to have a dragging power greater than one-14th of the weight upon their driving wheels. Now, in other countries, one-17th of the weight is considered a standard and satisfactory performance, while American locomotives regularly work up to one-5th in winter, and do rather more in summer. That is to say, a European locomotive weighing 88,000 pounds, might be expected to pull a train equal in resistance to lifting 12,571 pounds, while an American locomotive would pull 19,555 pounds, or 55 per cent more. The average locomotive of Europe travels 15,720 miles per year, while the American performance is 21,900 miles. The reason assigned is simply that the American machines are better ones, and two chief improvements on the European prototype are mentioned: First, the leading wheels of locomotives and all car wheels are not rigidly attached to the frames, but are fixed to trucks pivoted to the center; and, secondly, equalizing levers are used to distribute the weight equally over the driving wheels, thus keeping its apportionment nearly constant, while the wheels are free to adapt themselves to all the irregularities of the track. These and other improvements have reduced the resistance of cars so much, that recent experiments have developed a rolling friction of only four or five pounds per ton, or, actually, only half that given in engineering note-books. Our railroads have cost less than half as much per mile as the European, and competition has also greatly reduced the profits on the total capital invested. Thus, in 1878, our roads earned 3.93 per cent, the English 4.4 per cent, and the French and German each 5.1, which is the greatest percentage of profit. Between 1868 and 1877 the rates of toll have been reduced in New York 56 per cent, and in Massachusetts 45 per cent, while in Germany they were only reduced 22½ per cent. The lowest charge per ton per mile on English traffic is ⅞ of a cent on minerals, as against a regular rate between New York and Chicago of ⅝ of a cent on grain, etc., and, at times, only one-fifth of a cent has been charged. The 23 miles in operation in 1830 have risen to over 86,000 in 1879, the greatest annual increase having been 7,369 miles in 1871. Thus, our 50,000,000 inhabitants have provided themselves with 41 per cent of the total railroad mileage of the world, the 306,000,000 of Europe having 98,000 miles, or 47 per cent.

Bronzing Iron.

The *English Mechanic* gives the following directions for bronzing iron: To 1 pint of methylated finish add 4 ounces of shellac and ½ ounce of benzoin; put the bottle in a warm place, shaking it occasionally. When the gum is dissolved, let it stand in a cool place two or three days to settle, then gently pour off the clean mixture into another bottle, cork it well, and keep it for finest work. The sediment left in the first bottle, by adding a sufficient quantity of spirits to make it workable, will do for the first coat or coarser work when strained through a fine cloth. Next get ½ pound of finely ground bronze green—the shade may be varied by using a little lampblack, red ocher, or yellow ocher; let the iron be clean and smooth, then take as much varnish as may be required, and add the green color in sufficient quantity; slightly warm the article to be bronzed, and with a soft brush lay on it a thin coat. When that is dry, if necessary lay on another coat, and repeat until well covered. Take a small quantity of the varnish and touch the prominent parts with it; before it is dry, with a dry pencil lay on a small quantity of gold powder, and then varnish the whole.

Explosion of a Locomotive Boiler.

From the bulletin of the Hartford Steam Boiler Inspection and Insurance Co., we select the following case, the report upon which is, as usual, lucid and instructive. The locomotive "Saco," on the P. & O. R. R., four years old, built of ⅜ Bay State plates, working at 130 pounds pressure, exploded in the city of Portland, September 22, 1874. The crown of the shell over the furnace was joined to the sides by double riveted seams about 8 inches below the crown of the furnace, and a line of screw stays was placed as near as possible to the inner lap of the seams. The breadth of the fire-box was less than the diameter of the shell-crown, which consequently formed something more than a semi-cylinder. A goodly number of vertical stays connected the furnace crown and the shell crown. On the day of the accident the fireman reported a leak in or near the seam on the left side, and shortly after the shell crown turned over toward the right side, hinging on the top line of the screw stays on the right side; breaking along this line on both sides almost simultaneously, it flew away, with dome and broken stay rods, into an adjoining field. The engineer, who was leaning out of the front window of the cab, was instantly killed, but the firemen and others who were on the tender escaped with slight injuries. The upward expansion of the furnace would tend to thrust the top upward, and the form at the seams was favorable for the sharp bending of the plate on the inner laps, caused by the pressure on the shell crown. The disturbance of the fibers was probably so serious that the iron, on recovering its original form by the cooling of the boiler, did not recover its original texture, and the water attacked the weak line while the engine was idle, oxidizing a portion of the disturbed fibers. On raising steam, the bending again occurs and the oxide is cracked off, and so the weakening process goes on till the limit of endurance is almost reached, when a jar or sudden rise of pressure was all that was required to precipitate the disaster by breaking it along the whole line at once.

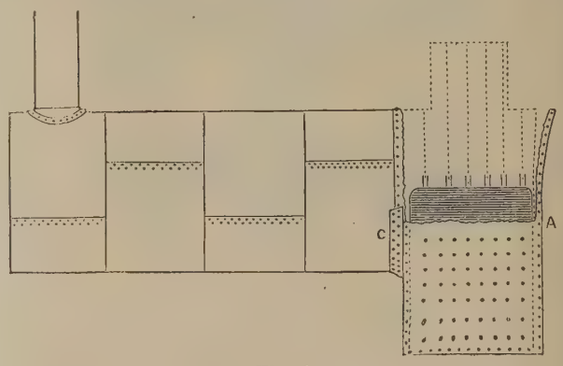


Fig. 1.

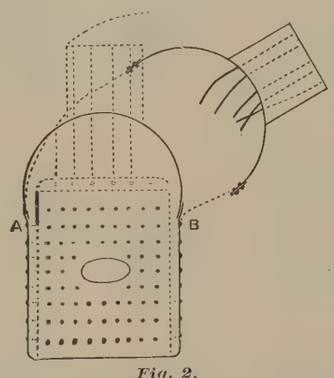


Fig. 2.

It was suggested that the closely huddled tubes might have repelled the water, which assumed the spheroidal condition among them, and on the occurrence of sufficient disturbance in the water, it returned upon the overheated surfaces, and by rapidly absorbing their stored-up heat, caused a sudden rise of pressure. But the tubes were light, and the portion of them that would be likely to become overheated under 130 pounds pressure would afford but very small storage capacity for heat, and they would not be likely to raise the temperature of the mass of water to a degree that would be dangerous to a *sound boiler*.

It is claimed that sudden variations of pressure to a dangerous extent do occur, as in the case of the explosion of a locomotive in Pennsylvania, where, according to the local press, the expert says that the "explosion was produced by the projection of foam upon the heated crown bars of the furnace, caused by suddenly and widely opening the safety-valve at a time when the water had been permitted to get so low as to overheat the crown of the furnace." It is more than probable, however, that some such defects as those in the "Saco" existed in this boiler.

While it is known that violent changes in pressure *are not* necessary to produce destructive explosions, yet they may happen to all kinds of steam generators, and the only rational means of ascertaining whether they retain an ample margin of strength to enable them to safely withstand them, are careful and oft-repeated personal inspection, whereby the inception and progress of inevitable deterioration may be observed and recorded for future guidance.

Fig. 1 is a side elevation, the broken lines showing the part blown away. Fig. 2 is a section through the front water space, showing the form of the double riveted seams at A and B.

The question of the need of stays in this case is a pertinent one. Except for the support of the top of the dome, it is doubtful whether they are needed at all. If the portion of the cylinder which formed the wagon top is just exactly in shape what the internal pressure would make it, then it is stronger without them, and the dome top had better be stayed to its own sides if staying must be done to support its top. The effect of the upward motion of the furnace would be to thrust the dome upward and flatten the arc between the base of the dome and the point A, Fig. 2, the place of rupture.

Fiber Culture in New Jersey.

The State Legislature of New Jersey has passed an act designed to encourage the growth of fibrous plants, including jute, ramie, flax, hemp, and various other plants and grasses grown elsewhere in the United States, or imported. Its principal features are as follows: For every ton (of 2,000 pounds) of *Abutilon avicennæ* stalks grown in New Jersey, not less than 3 feet long, $5; for every ton of what is known as rose, or marsh-mallow, not less than 3 feet long and not more than 1 inch in diameter at the butt, $5; for every ton of ramie stalks not less than 2½ feet long, $10; for every ton of flax stalks for fiber of the ordinary lengths, $7; for every pound of decorticated or cleaned flax of first American quality, 3½ cents; for every ton of hemp stalks of the ordinary lengths, $6; for every pound of decorticated or cleaned hemp of best American quality, 3 cents. In each case fractions less than a quarter of a ton, are paid for at the same rate. The bounties will cease the 1st day of April, 1885, or in the event of the total amount paid reaching $15,000.

WOOL-GROWING IN THE UNITED STATES.—The United States ranks to-day as one of the greatest wool-growing countries in the world. The clip of 1879, according to trade estimate, was 232,500,000 pounds. This does not equal the English product, but the increase is a steady and reliable one, and the American wool production may now be said to be upon a firm and prosperous basis. In the course of time we shall head the list of nations in wool as we do in cotton. The prosperity of American wool production is the natural result of the increase of the domestic manufacture of woolen goods.

New Accessories for the Microscope.

Several devices that have been highly praised by reason of the facilities which they afford for the study of living forms beneath the microscope, are shown in the accompanying engravings. They have been devised by Mr. D. S. Holman, an officer of the Franklin Institute, and an experienced practical microscopist.

Fig. 1 shows an improved form of compressor. It is arranged differently from other devices of this kind in that the mica cover is fixed and immovable, while compression of the cell contents is effected by moving the lower plate of glass, which is done by means of a screw-nut and spiral spring. This arrangement avoids the troubles attendant on the use of other forms of compressors, among which may be named the risk of breaking large and costly cover glasses, crushing the object under examination, or injuring the high power lenses; while in addition it permits of the application of any degree of pressure that may be necessary in examining any soft or yielding object, with security and precision.

Fig. 2 shows the familiar animalcule cage, to which is attached a pair of tubes which are made to act as a siphon. The circular edge of the cover glass is beveled, and by proper manipulation it can be made to act very well as a compressor. The siphon attachment, by the facility with which it can be arranged to rapidly or slowly renew the water in the cell, gives the device a special value as a moist chamber for studying growing fungi and other minute and delicate plants, without disturbing them. Aquatic larvæ, worms and the like, may also be kept alive for a considerable time in the cell, either for study or exhibition purposes.

Mr. John A. Ryder, a member of the United States Fish Commission, and one of our most promising biologists, considers these devices to be indispensable to every working microscopist. As a proof of their value, he states that it was in one of Mr. Holman's siphon slides, right under the microscope, that he successfully hatched young shad—a feat never before performed with the eggs of fishes.

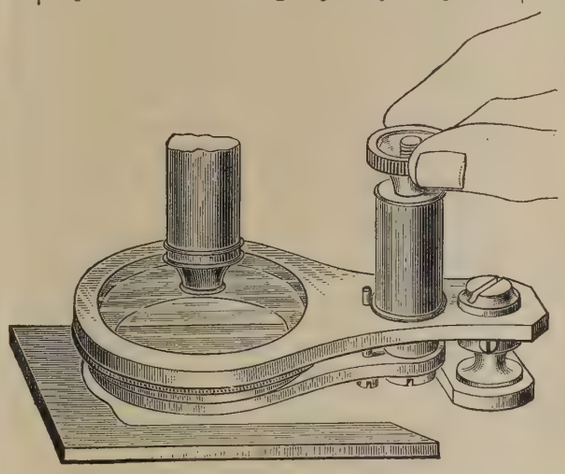


Fig. 1.

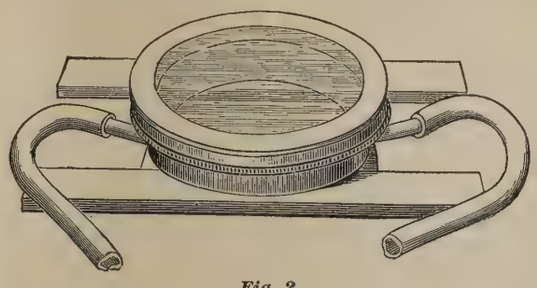


Fig. 2.

Cork and its Uses.

The cork oak closely resembles the *Quercus ilex*, or evergreen oak, so well known in English shrubberies. It is indigenous to the mountainous regions of Spain, Portugal and the south of France. It grows from 30 to 40 feet high, and from 2 to 3 feet in diameter. Spain and Portugal supply the greatest portion of the cork which is used in Europe; abundant supplies are also received from the south of France at the foot of the Pyrenees, the islands of Sardinia and Corsica, and the forests of Algeria. When this tree is about five years of age, the cork, which composes the greater part of the bark, begins to increase in a very remarkable manner. Nearly all of its vegative activity seems to be concentrated on this part, which grows unusually large, thick and spongy. If left on the tree it becomes cracked, and so deeply fissured that it is unfit for use. It is, therefore, removed before this happens. Its removal does not injure, but is beneficial to the tree, for if the cork is allowed to remain on its stem the cork oak seldom lives longer than 50 or 60 years; if, on the contrary, it is removed, the tree flourishes sometimes for upwards of 150 years.

After the tree is 30 years old its cork may be removed at intervals of from 6 to 10 years. The first crop of cork is inferior in quality, and is principally used for making floats for fishing nets. The crops are usually gathered in the months of July and August. Two opposite longitudinal incisions into the bark are made the whole length of the stem, and then several transverse ones about 3 feet apart. The bark is now beaten to separate it from the subjacent fiber, and detached in cylindrical pieces for inserting under it the handle of the instrument, which is curved and made thin at its extremity for this purpose. In effecting this removal great care is taken not to injure the newly formed suber, or cork—namely, the living layer of cork beneath. After barking, the pieces of cork are slightly charred to close the pores, then loaded with weights to flatten them, and finally stacked in masses in some dry place, where they remain for two or three months. In drying they lose one-fifth of their weight. Only when the trees are 40 or 50 years old is the bark sufficiently matured for making good corks. This substance is valuable for bottle corks, because it is light, porous, compressible, and sufficiently elastic to adapt itself to the neck of a bottle. It can be cut into any shape, and, notwithstanding its porosity, is impervious to any liquid. These qualities make it superior to all other substances as a stoppering for bottles, for which it is principally used.

The lightness of cork makes it superior to all other substances for life-preservers, and for insuring the buoyancy of life-boats; it is also employed in the making of water-proof shoes. It has also been converted into and used as gun-wadding. Cork, as is well known, is a non-conductor of heat, and is porous. These peculiarities have been taken advantage of in the manufacture of water-coolers, which are much used in Spain. They are made of slabs of the wood, bent round circular heads of the same, and bound with hoops. The porosity of the cork allows the water to percolate slowly to the surface and there cool in evaporating, while its non-conducting nature prevents the heat of the sun warming the water within. In ancient times the Spaniards lined the walls of their houses with cork, because it kept them warm and prevented dampness. The Roman ladies used it as soles to their shoes to make them appear tall—there were no high heels in those days. Camillus swam the Tiber with the aid of a cork jacket, and Pliny tells us that it was employed as stoppers to vessels of all kinds. The Egyptians manufactured coffins of it, which, being filled with a resinous composition, preserved their dead from decay.

About thirty years ago an ingenious Frenchman introduced mattresses and cushions in which cork, reduced to dust or shreds, was a substitute for feathers, hair or wool. It might be used alone or combined with the above mentioned materials. It was claimed that these would make easy beds—smooth, light and elastic, and especially well adapted for use at sea, where, in cases of emergency, they might be available as life-preservers. But it is evident that cork mattresses did not become popular. A variety of walking-sticks are manufactured from young cork trees in Africa; and Spanish black, a superior pigment, is made of calcined cork.

The Future of Steel.

J. S. Jeans, Secretary of the British Iron and Steel Institute, lately made the following remarks respecting the subject heading this article. The opinions therein expressed are substantially those given in this journal some months ago:

"The more the subject of the manufacture and uses of steel is inquired into, the more does it seem incapable of exhaustion. Great things have been accomplished in the past, but much yet remains in the future. The manufacture of steel is far from finality. Even now some of the leading steel works in France are essaying the production of ingots of 100 tons weight. Steel, indeed, may be compared, in reference to its multifarious uses, with the elephant's trunk, the adaptability of which enables it with equal ease to pick up a needle or pull up a tree. High authorities have expressed the opinion that steel will have the future nearly altogether to itself, displacing copper for fire-boxes, etc., silver for articles of ornament, and lead for its specific purposes, as much as it is superseding iron in respect to utility, economy and endurance. And as it is difficult to set bounds to the ultimate applications of steel, so it is impossible to limit the means of its production. Recent metallurgical progress has indefinitely increased the resources available for the latter purpose. Science has at last found a method of ridding of their deleterious contents the ores of iron heretofore unsuited for the manufacture of steel, and henceforth, if metallurgists of experience are not greatly deceiving themselves, the cheapest and most plentiful ores will, by one of the greatest chemical triumphs of the age, be raised to the same rank as the richer and comparatively limited ores that have alone been deemed fit for steel manufacture until now. The horizon of the future, therefore, is not bounded by any limitation of the supplies of raw material. Nor is it any more likely to be measured by the uses of steel, for they are multiplying every day, and as the manufacture is cheapened and improved, so will the applications continue to increase. In the track of this movement many changes must follow, and have even already occurred, of which we have been able to take but scant cognizance. The hard and irksome work of the puddler has been superseded by less arduous, and, in the main, by less skilled labor. One of our greatest authorities has calculated that to convert fluid cast iron into steel, the labor required is only about one-third of that needed to convert pig metal into wrought iron, while the fuel consumed is only about one-fourth of that formerly used. The economy of coal is, therefore, another important corollary of the advance of steel; and this economy, great though it be in the aggregate, is trifling in comparison with that accomplished through the greater strength and endurance of that which we are fully justified in describing as the metal of the future."

Punching Iron.—An interesting experiment was reported at the last meeting of the Engineers' Club, of Philadelphia, by Mr. Percival Roberts, to show the small quantity of iron that is removed in the process of cold punching that metal. A section of a partly punched nut was exhibited, etched by acid, to show the solid metallic flow of the metal induced by the cold punching process. The section demonstrated that only 40 per cent of the volume of iron leaves the hole, thus proving that a cold-punched nut must be much stronger than one that is hot-punched.

Scientific.

Comparative Energy of Explosives.—It will be of interest, in view of the extravagant claims often put forth by the manufacturers of patented explosive compounds, to place before our readers the most authoritative statement of the comparative value of the best known explosive substances. It will be well in scanning the table given below, to remember that nearly all of the patented explosive compounds offered to the public within the past ten years, are mixtures of nitro-glycerine with other substances of much inferior explosive energy, and that on this account the absurdity of claiming that such mixtures can have equal or superior explosive power to nitro-glycerine pure and simple, is apparent on its face; and yet such extravagant statements have been made. It should be known, once for all, that pure nitro-glycerine is by far the most energetic explosive known to science up to the present day, and that the addition to it of any other explosive, with the ostensible object of increasing *its* explosive energy, is about on a par with the plan of improving the speed of a racer by harnessing him with a worn-out cab-horse.

Messrs. Roux and Sarrau have given us the following facts respecting explosives, which give the most reliable estimate of their respective values that we have. They found in their experiments that two kinds of explosions could be manifested by the majority of explosive substances, according as they are made to deflagrate—which they call explosion of the second order—or to detonate, as by the percussion of a fulminating powder, which they call explosion of the first order.

They found, furthermore, that the energy of the explosion produced by the same quantity of explosive, is very different in the two cases, being invariably more powerful in the case of a detonative explosion than in the other. They give the several best-known explosives the following values as to their explosive energy, the figures being based on the explosive energy of gunpowder, which is taken as unity:

Name of Explosive.	Explosive Force. Second Order.	First Order.
Mercury fulminate		9.28
Gunpowder	1.	4.34
Nitro-glycerine	4.80	10.13
Gun-cotton	3.	6.46
Picric acid	2.04	5.50
Potassium picrate	1.82	5.31
Barium picrate	1.71	5.50
Strontium picrate	1.35	4.51
Lead picrate	1.55	5.94

From these tables it appears that the detonative explosion of nitro-glycerine surpasses in energy that of any of the other explosives. It should be remembered, finally, that nearly all of the patented explosives now in use, such as lithofracteur, rend-rock, dynamite, giant-powder, vigorite, and many others the names of which we do not now recall, are mixtures of nitro-glycerine with inert substances, or with less energetic explosives, and that the explosive energy which they will develop depends entirely on the percentage of nitro-glycerine that they contain.

A Simple Safety Test for Petroleum Oil.—The cheapness of the lighter and volatile products of petroleum, known commercially as naphtha or benzine, is a standing temptation to dishonest refiners and dealers to adulterate their kerosene with the dangerous stuff; and the inefficiency and complaisance of the inspectors appointed to prevent this dangerous imposition on the public, allows it to be carried on almost universally. That this is the case, no other proof need be adduced than the constant occurrence of coal-oil accidents by the explosion or breaking of lamps and the like, which the newspapers record from day to day, and which would be impossible with unadulterated oils.

To show how the addition of even a small percentage of benzine will affect the safety of kerosene, we give below the results of the experiments of Dr. D. B. White, of the New Orleans Board of Health, upon an oil which had originally a flashing point of 113°, or 3° above that specified by the law—namely, 110° Fah. He found that the addition to this oil of

1	per cent of benzine	caused it to	flash at	108°	Fah.
2	"	"	"	92°	"
5	"	"	"	83°	"
10	"	"	"	59°	"
20	"	"	"	40°	"

and that after the addition of 20 per cent of benzine, the oil *burned* at 50° Fah., or considerably below our average summer temperature, or the temperature of our houses in winter.

Prof. Chandler has given the following very suggestive estimate of the profit accruing to the refiner from the adulteration of his kerosene: "On every gallon of naphtha (benzine) run into the kerosene tank, there is a profit to the refiner of 20 cents; or on every per cent of naphtha added to the kerosene, a reduction of one-fifth of a cent per gallon in the cost of production, which, with kerosene at 25 cents per gallon, amounts to 1¼ per cent. For every gallon of naphtha sold as kerosene, the refiner can afford to throw away four gallons."

So long as these volatile products are so cheap, there will be a standing temptation to the refiner to adulterate the more valuable burning oil with them; and so long as the enforcement of inspection laws respecting this commodity is committed to the care of small-beer politicians, petroleum will continue to be adulterated.

This being the case, it will not be amiss to present to our readers, whose families and homes are liable to accidents and injury from this almost universal source of danger, a simple precaution, which, if taken, will render them comparatively safe against the cupidity of the refiners and dealers on the one hand and the supreme ignorance and indifference of inspectors on the other. This test is not a new one, but will bear repetition, and it commends itself by reason of its extreme simplicity. Before purchasing petroleum for use in the household lamp, pour a tablespoonful of it into a saucer and apply a lighted match. If it extinguishes the match, the oil is practically safe; if the oil takes fire, reject it.

If this simple rule were only generally known and applied by all who buy petroleum, coal-oil accidents would cease to occur, and inspectors would be as unnecessary in law as they are useless in fact.

The Virtues of the Australian Fever Tree.—A late number of (London) *Nature* contains the most positive evidence we have yet noticed respecting the value of the *Eucalyptus* in banishing the unwholesomeness of malarious districts. In many fever-plagued regions, notably in Southern Italy, Corsica and Algeria, where, during certain seasons, the atmosphere was literally pestilential, the experiment of cultivating the *Eucalyptus* in large numbers was undertaken some years ago, because of its reputed virtues, and the results are now said to be very satisfactory. A recent report to the French Academy respecting the value of the *Eucalyptus* in banishing fevers from marshy districts of Corsica and Algeria, states in very positive terms, that where it has been planted endemic fevers have been banished. Specific mention is made in this report of certain pestilential localities in the neighborhood of Algiers, where, since the planting of the trees, the region has been rendered wholesome and habitable. This evidence of the sanitary value of the *Eucalyptus* is substantiated by other testimony no less convincing. It is affirmed that large tracts of land have been transformed, through the agency of the fever tree, and that wherever it is cultivated fevers are found to diminish in frequency and intensity. The most interesting evidence on this point is that relating to the so-called Roman "Campagna," a low-lying district surrounding the city of Rome, and which has for years had a world-wide notoriety as a veritable hot-bed of pestilence. The experiment of planting the *Eucalyptus* in this region was extensively made some years ago by the Italian government, and the sanitary effects of this measure, it is said, are already strikingly apparent. It should be said, however, in this connection, that the sanitary condition of this region must have been decidedly improved by reason of the drainage of extensive districts of low land which has lately been effected; so that in this case, at least, the evidence of the value of the fever tree is not so clear as in the others.

Meat-Bread.—An interesting observation which bids fair to receive an extensive practical application, is reported to have been made by M. Scheurer-Kestner. This savant discovered the noteworthy fact that meat, when added to bread, during the process of fermentation, disappears entirely, its nutritive principles being incorporated with the bread. In this condition the meat appears to be capable of being preserved for a lengthened period, as the discoverer above named exhibited to the French Academy specimen loaves of meat-bread made several years before, which showed no signs of either worms or moldiness.

In the account given of his experiments, he states that at first he used raw meat, three parts of which, finely minced, he mixed with five parts of flour, and the same quantity of yeast. Water was added in sufficient quantity to make a dough of proper consistency, and the mass in due time underwent fermentation. In two or three hours the meat had disappeared, having undergone a species of digestion in the fermenting mass, and the bread was baked as usual. The taste of the meat-bread thus prepared was disagreeable and sour, an objection that was subsequently obviated by first cooking the meat for about an hour with enough water to afterwards moisten the flour. The meat used for the purpose should be carefully freed from fat, and only enough salt added to give the necessary flavor, as the addition of too much would, by its property of absorbing atmospheric moisture, spoil the bread. The proportions recommended, are ½ of meat to 1 of flour, in which quantities the meat will be thoroughly incorporated during fermentation. Meat-bread, prepared with a suitable quantity of veal, is asserted to make an excellent, nutritious soup for the sick and wounded.

A New Way of Studying Sounds.—A new and simple way of producing colored rings, which seems capable of some interesting applications, has been recently brought to public notice by M. Guébhard. A saucer filled with not very pure mercury is all the apparatus required. Then clear off with a piece of card or paper the thin pellicle of oxide and dust, breathe on the bright surface, and a magnificent system of colored rings is given by the film of condensed moisture formed thereon. Instead of the four or five "irises" described by Newton, six or seven can be well made out, and the thickness of the film increasing from the border inwards, the order of hues is reversed. Still better effects can be had by dropping volatile substances (as petroleum oil) on the mercury surface, instead of breathing on it; but the most remarkable results are had with collodion. Diluted with ether, this gives pellicles on the mercury, which may be detached (after their thickness and colors have been regulated at will) and transferred to paper. M. Guébhard has utilized these effects in the study of the sounds of the voice. Vowel sounds uttered above the moistened mercury surface produce characteristic ring figures which throw new light on the nature of the vibrations involved. The vibratory state, indeed, for vowel sounds, appears to be often very complex, the figures presenting groups of several ring systems, indicating several centers of percussion.

Experiment in Magnetism.—An interesting experiment in magnetism has been described to the French Academy by M. Obalski. Two magnetic needles are suspended by fine threads attached to unlike poles over water in a vessel. Their distance from each other is a little greater than the sum of their radii of mutual attraction, and their poles are opposite each other. The water is gradually brought up over them by means of a tube of caoutchouc connected with the vessel and

wound on a drum. When immersion commences, the needles approach each other by their immersed parts, and when the immersion has reached the third or fourth of the needle's length they rush together. The explanation seems to be that what hindered the approximation of the needles was their own weight, and the force of gravity being neutralized by the immersion, the magnetic forces became manifest. A corresponding, though opposite, phenomenon is witnessed when the needles are suspended by their poles of the same name.

The Observation of the Circulation of the Blood in living creatures has always been regarded as the most interesting and instructive sight that the microscope could afford. The delicate membrane of the foot of the frog has hitherto afforded the microscopist the most convenient subject for this beautiful demonstration of Harvey's discovery. Perkinje's experiment, by which an observer is enabled to note the circulation in his retinal blood vessels, has hitherto been the only method known of actually showing the circulation of the blood in the human subject. Dr. Huber, of Greifswalde, it may interest our readers to know, has lately described a simple experiment by which it is possible for an observer to see the circulation of the blood in the blood vessels of another person. Dr. Huber fixes the head of the subject to be examined in a frame not unlike that used by photographers, on which is fixed a holder for the microscope and lamp. He then draws down the lower lip of the subject upon the stage of the instrument, with its delicate inner surface upward for inspection, throws a strong light on the same with a condenser, and focuses the microscope, provided with a low objective, down upon the delicate network of blood vessels, which can be seen there even with the naked eye. By this simple means the circulation can be observed with the greatest ease and perfection. The value of this novel and beautiful experiment in the study of the abnormal conditions of the blood, presented in various diseases, it is anticipated, will be very great, and important results are expected to flow from it. Huber distinguishes his new process by the terrible name of "Cheiloangioscopy."

Artificial Coloring Matters.—The production of the madder root, which, until within the past eight or ten years, was for centuries a flourishing agricultural industry in France and Germany, has been almost entirely abandoned by reason of the manufacture of artificial alizarine — the coloring principle of madder. This valuable substance, like the beautiful aniline dyes, is manufactured from that most unpromising material —coal tar. The cost of alizarine to-day is said to be only about one-third the average price of madder in former years.

The chemist's skill has created a whole series of magnificent dyes from the light oils of coal tar, and to-day the estimated value of the coal tar colors is about $16,000,000 yearly. Ultramarine, the blue color prepared from lapis-lazuli, which cost in 1820 nearly $400 per pound, is now prepared by artificial means, and sold for about 25 cents per pound. The extent of this industry is enormous, the yearly production being estimated at about 22,000,000 pounds.

At no distant day we may expect to see the indigo industry go the way of the madder industry. Baeyer, an eminent German chemist, has, after years of labor, succeeded in producing this dye by artificial means, and has lately devised a process for producing it on the commercial scale.

Electro-Plating as a Substitute for Casting.—The Electro-Metallurgical Company of Brussels have been very successful in producing artistic objects of large size, such as statues, etc., in bronze by electro-deposition, in place of the process of casting, which has hitherto been uniformly used for that class of work. The statement has lately been made respecting this company, that they have succeeded by their process in producing a colossal statue of Van Eyck, the great Flemish painter, by the electro-deposition of copper upon the clay model. A similar process for the production of bronzes of moderate size is thus described: Take the figure or group of plaster and saturate with stearine (or its equivalent), then give the surface a uniform coating of black-lead, and immerse in the usual copper bath. Attach a very weak battery, and deposit very slowly a thin coating of copper. Now remove from the bath, and bake in an oven until the plaster model shakes out in dust. We have now a very thin copper reproduction of the model. The outside is then varnished so as to prevent the further deposition, and replaced in the bath; the copper will now be deposited on the inside surface, which can be thickened up to any desired point. For this second process a much stronger battery may be used.

Diagnosis by the Microphone.—The principle of the microphone in medical and surgical diagnosis has recently been lectured upon by Sir Henry Thompson, of London. He showed how a small acoustic wave is converted by it into a large electrical vibration, which is reconverted into sound at the diaphragm of the telephone, where it is received by the ear of the operator. Thus, in case of stone in the bladder, the minute wave transmitted through the sound on its impact with a very small stone, is so magnified that the operator is enabled to determine with certainty the presence of the smallest stone or particle of stone, or other foreign substance. These experiments, it appears, were conducted with a couple of steel sounds, each fitted with the microphone, and an artificial bladder, in which was concealed, in turbid fluid, a naturally formed uric acid stone, about as large as a pea.

M. A. Mouchot says he has been able, on a practical scale, to utilize solar heat directly in a number of chemical operations, such as the calcination of alum, the manufacture of benzoic acid, the distillation of sulphuric acid, the production of wood charcoal in closed vessels, etc.

The Electric Light for Light-Houses.

The last report of the United States Light-House Board is valuable in containing some useful information respecting the comparative merits of the several forms of the electric light, and of the several appliances that have been devised for producing it. The report on this topic discusses, (1) the modes of producing electric illumination, (2) the instruments for producing electrical currents, and (3) the results of measurements of luminous intensity.

Respecting the first category, the report notices three modes of producing electric illumination; (*a*) by the electric arc, (*b*) by ignited conductors, and (*c*) by incandescent gases. Respecting the electric arc, the report comments upon several objections attending its use. It is unsteady, and the carbon poles wear away and are gradually consumed; and the point is made that while very ingenious regulators have been devised to overcome the troubles and inconveniences arising from these causes, they cannot control the accidental variations in the structure of the carbon poles, which causes them to wear away unequally, and by reason of which the arc shifts its position, giving rise to frequent and often considerable variations in the intensity of the light that it emits.

The report refers to certain observations on this point, from which it appears that variations in luminous intensity from this cause were noticed, within a few minutes, of from 400 to 2,000 candles. The remark, however, is appended, as a qualifying clause, that "since the great improvements recently made in the homogeneity of the carbon poles, and in the regulating machinery, and since the introduction of reflectors, the electric arc is no longer too unsteady for practical purposes."

On the production of the electric light from incandescent conductors, the report is decidedly unfavorable. It affirms that this method of producing electric illumination is open to the grave objections of great wastefulness of energy (and consequent costliness) and the rapid destruction of the conductors by disintegration. A current, for example, that would furnish an electric arc of from 1,000 to 2,000 candle-power, would not generate a light of more than 50 to 100 candle-power with platinum wires, and the platinum soon became brittle and broke up. Better results were obtained with carbon rods placed in exhausted glass tubes, but the carbons soon disintegrated. The report is unfavorable to lamps of this class, and the fact is worthy of mention, that the experiments upon which the conclusions just stated were reached, antedate those of Mr. Edison which lately attracted so much attention.

Respecting the practicability of subdividing the electric current, which is one of the indispensable prerequisites of any system of electric lighting adapted for domestic uses, the report gives some interesting and suggestive figures of the great loss of energy which such division now entails. A current of given strength, for example, when concentrated on a single lamp, gave a light of 65 gas jets (of 16 candles each); when divided between two lamps, the light was reduced to 7½ each; among three lamps, it gave 1½ gas jets each; among four, ¾ each; and among five, ½ each.

The report also describes and explains the action of 17 magneto-electric machines, and gives the results of a number of comparative tests of the economy and illuminating power of some of the best known of these machines and lamps.

Arctic Exploration.

It may be interesting to mention, that Arctic exploration is more actively prosecuted this year than ever before, there being, according to report, more expeditions simultaneously engaged in the work of exploration than have ever before been employed in the Northern seas at one time. Of these expeditions, the following deserve special mention: M. Sibiriakoff, the wealthy patron of Prof. Nordenskjöld, has fitted out a vessel at Yokohama, Japan, to proceed from that port and to endeavor to make the passage of the Polar Ocean westward to the Atlantic. This expedition will, therefore, endeavor to accomplish the feat of Prof. Nordenskjöld of passing from ocean to ocean by the northern passage, but in the opposite direction from that followed by the illustrious explorer above named.

It is reported also that several Scandinavian shipowners intend, during the summer, to send ships to the Obi, Yenesei, and other Siberian rivers, on commercial ventures, on the strength of Prof. Nordenskjöld's assertion that the voyage could be made without unusual hazard.

Another expedition, that of Mr. James Gordon Bennett, undertaken for the purpose of reaching the North Pole, should also be noticed. This expedition is represented by the steamship "Jeannette." This vessel entered the Arctic region by way of Behring's Strait, and has wintered there. Nothing definite has lately been heard of her.

An American overland expedition to King William's Island via Repulse Bay, in search of relics of the ill fated Franklin expedition, should also be named.

Finally, we have the Howgate expedition, to test the value of the plan of establishing stations or colonies, and gradually pushing these forward until at length the Pole is reached. The steamer "Gulnare," charged with the task of establishing the pioneer Polar colony, has sailed for Smith's Sound for the purpose, and the colony will be planted somewhere about latitude 82° N. This station will be maintained as long as may be necessary, and a vessel will pay it an annual visit with fresh supplies and recruits, while the colonists, as rapidly as they become acclimatized, will push their stations further to the North.

Germany and Italy, it is reported, have each decided to send out an Antarctic expedition; and lastly, a British Arctic expedition is about being organized to test the feasibility of the plan of Commander Cheyne, who designs to reach the Pole with the aid of balloons, sent out on favorable occasions from the most northerly point which it is found possible to attain by ordinary methods.

The Improved Pulsometer Pump.

All of our mechanical readers are familiar with the variety of pump known as the pulsometer, which, because of its novel and peculiar construction and mode of action, attracted wide-spread attention when it was first brought before the public some six or eight years ago. These pumps have been extensively introduced, and the manufacturers have of late succeeded in substantially improving the apparatus, as those who are acquainted with the details of the earlier pulsometer will observe from the following description, reference being had to the subjoined engravings.

The pulsometer has been described as a steam pump with no cylinder, no piston or piston-rod, no stuffing-boxes, glands, cams or eccentrics, no slide valves, cranks or fly-wheels, and no exhaust. The new pulsometer, while retaining all the distinguishing features of the earlier pumps, has been substantially improved in detail, and in its present form is asserted to combine great strength, durability and efficiency, with such simplicity of construction as to render it difficult to get out of order, and with such economy in operation as to place it in advance of many machines of its class, and on a par with the best.

The details of the pulsometer will appear from an inspection of Fig. 1. Two iron chambers A A, with tapering necks, are formed in one casting side by side. They join at their upper extremeties, forming a common passage, in which a metal ball C, acting as a valve, is fitted so as to oscillate freely between seats formed at the junction of the necks, closing the orifice of one or the other of the chambers towards which it may fall. The upper section of the pulsometer containing this ball valve, it will be seen, is made separately, and bolted to the body of the apparatus, so that it may be removed, when worn out, without the necessity of replacing the entire pump.

Steam is admitted above, and the position of the ball C determines its entrance into one or the other chamber. Water enters the pump from below through the vertical induction passage D, by way of suitable openings communicating with the chambers, and which are controlled by valves E E of vulcanized rubber. H is the delivery passage, common to both chambers, and its valve seats G G (seen best in Fig. 2) have valves similar to those provided in the induction passage; J is the vacuum chamber, which is connected with the induction passage below the valves E E. The chambers are made accessible for inspecting the valves and their seats, by lateral openings provided for the purpose which are closed by the covers K K. The

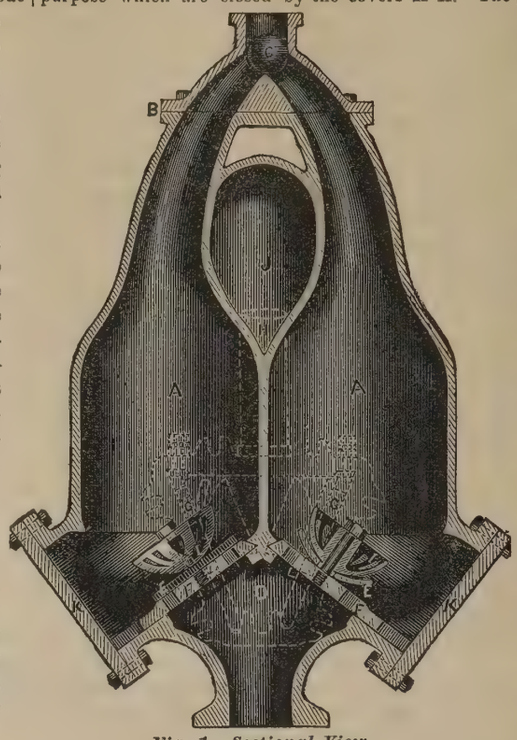


Fig. 1.—Sectional View.

neck of each chamber, and the vacuum chamber likewise, are furnished with a small air check-valve. These are seen in Fig. 3, which shows a front view of the pulsometer. The purpose of these valves in the chamber is to provide for the admission of a small quantity of air above the water, to act as an air-piston and prevent condensation; and in the vacuum chamber, to cushion the water column and prevent the hammering that would otherwise occur as the chambers alternately fill.

In starting the pump, its regular action is established by opening and closing the steam valve four or five times. The steam supply pipe above and the suction pipe below having been properly connected, and the air check-valves being closed, the steam is turned on, and enters one of the chambers. When the steam supply is shut off, the steam in the chamber condenses, and the chamber at once fills with water through the induction passage below, by atmospheric pressure. As the steam condenses in the chamber, forming a vacuum, the ball valve C is caused thereby to shift its seat and to close the orifice of the chamber in question, and the orifice of the opposite chamber being thereby opened, it in turn is filled with steam. The shutting off of the steam supply causes this to condense as before, and this chamber in turn fills with water from the induction port, by atmospheric pressure. Meantime, the vacuum in the chamber just spoken of, has caused the ball valve to shift again, and the steam is again admitted to the first chamber, and pressing on the water with which it is filled, forces it out of the chamber through the discharge valve with a force proportional to its pressure. The shape of the chamber is such that the steam exposes at first only a small surface for condensation, which takes place suddenly at the opening of the discharge chamber. The chambers are, therefore, alternately filled and discharged, and after the action of the apparatus has been established by turning on and shutting off the steam four or five times, and the air check-valves properly opened, the action of the apparatus becomes automatic. The pulsometer is, therefore, a pump in which steam and water are contained in suitably arranged chambers, and, by the alternating vacuum and pressure of the former the latter is first lifted by atmospheric pressure, and then forced out through a discharge pipe provided for the purpose.

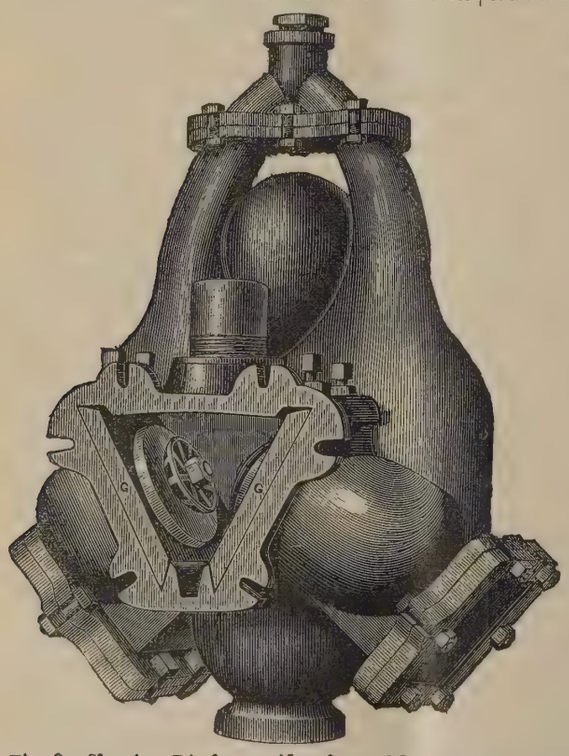


Fig. 2.—Showing Discharge Chamber, with Cover Removed.

The simplicity of its construction, and the absence of a multiplicity of parts to absorb power, are points which go far toward explaining the claims to economy made for the apparatus.

The No. 8 pulsometer, with suction and discharge pipes 5 inches diameter, occupying a floor space of only $20 \times 31\frac{1}{2}$ inches, with a hight of 54 inches, and weight of 1,300 pounds, will raise, as the makers claim, 750 gallons per minute, supplied with steam through a 1-inch pipe, the pressure necessary being determined by the hight to which the water is to be forced. For a 40-foot lift, a steam pressure of 40 pounds; and for a 70-foot lift, a steam pressure of 60 pounds is found to give good results in practice.

The makers further claim that the expenditure of power to operate these pumps, is less than one-half of that ordinarily required to do the same work by other means. The pulsometer is specially adapted to use in mines, for filling railway tanks, as a ship's pump, in tanneries, breweries, paper manufactories, and the like, since it is not readily clogged; and should this happen, the parts are readily accessible and the trouble can be speedily remedied.

The company manufacture body and valves of the pulsometer of various materials, to suit the requirements of special industries. The pump is made by the Pulsometer Steam Pump Co., 83 John street, New York, where further information may be obtained.

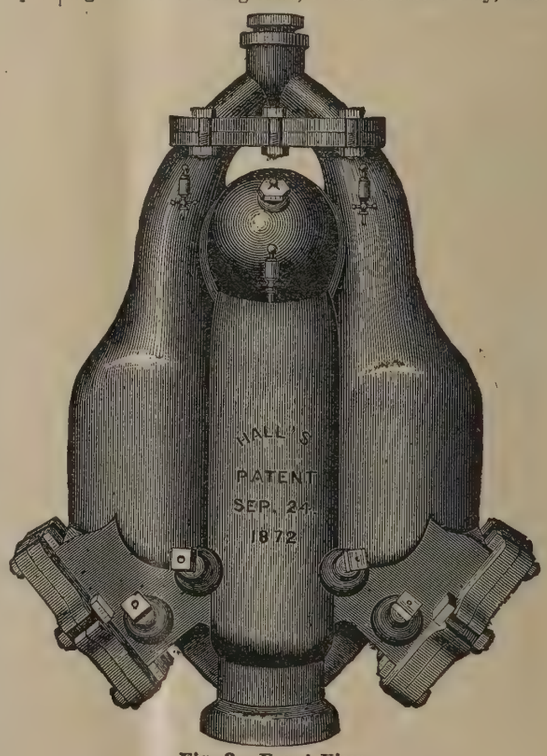


Fig. 3.—Front View.

CEMENT FOR CASTINGS.—For stopping holes in castings or for covering scars, a useful cement may, it is said, be made of gum arabic, plaster of Paris, and iron filings; and if a little finely-pulverized white glass be added to the mixture, it will make it still harder. This mixture forms a very hard cement that will resist the action of fire and water. It should be kept in its dry state, and mixed with a little water when wanted for use.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$60 00 a 70 00
Pine, good	52 00 a 55 00
Pine, shipping box	20 00 a 22 00
Pine, common box	17 00 a 18 00
Pine, common box, ⅝	15 00 a 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	42 a — —
Pine, tally plank, 1¼, 2d quality	35 a 38
Pine, tally plank, 1¼, culls	28 a 30
Pine, tally boards, dressed, good	28 a 30
Pine, tally boards, dressed, common	22 a 25
Pine, tally boards, culls, dressed	22 a 25
Pine, strip boards, merchantable	16 a 18
Pine, strip boards, clear	22 a 25
Pine, strip plank, dressed, clear	33 a 35
Spruce boards, dressed	20 a 22
Spruce plank, 1¼-inch, dressed	25 a 28
Spruce plank, 2-inch,	35 a — —
Spruce wall strips	14 a — 15
Spruce timber, per M	20 00 a 25 00
Hemlock boards, per M	15 00 a 16 00
Hemlock joist, 2½x4, each	15 a — 16
Hemlock joist, 3x4	16 a — 18
Hemlock joist, 4x6	40 a — 44
Ash, good, per M	45 00 a 47 00
Oak	50 00 a 85 00
Maple culls	25 00 a 30 00
Maple good	45 00 a 75 00
Chestnut	45 00 a 50 00
Cypress, 1, 1¼, 2, and 2½-inch	35 00 a 40 00
Black walnut, good to choice	85 00 a100 00
Black walnut, ⅝-inch	75 00 a 85 00
Black walnut, selected and seasoned	110 00 a150 00
Black walnut counters, per ft	15 a 20
Cherry, wide, per M	85 00 a100 00
Cherry, ordinary	60 00 a 80 00
White wood, inch	45 00 a 55 00
White wood, ⅝-inch	30 00 a 45 00
White wood, ⅝ panels	35 00 a 45 00
Shingles, extra sawed pine, 18-inch	4 00 a 5 00
Shingles, clear sawed pine, 16-inch	3 75 a 4 00
Shingles, cypress, 24x6	18 00 a 20 00
Shingles, cypress, 20x6	10 00 a 12 00
Lath, Cargo rate	1 65 a — —
Yellow dressed pine flooring	30 00 a 37 50
Yellow pine girders	32 50 a 40 00
Locust posts, 8 feet, per inch	18 a 20
Locust posts, 10 feet	24 a 25
Locust posts, 12 feet	29 a 34
Chestnut posts, per ft	3 a 3½
Basswood per M	25 00 a 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	2 75 a	3 25
Up Rivers	4 00 a	4 75
Jersey	— — a	— —
Long Island	— — a	— —
Haverstraw Bay	5 00 a	5 25
" " choice	5 50 a	5 75
Favorite Brands	6 00 a	6 50
Hollow Fire-Clay Brick	9 00 a	9 25

FRONTS.

Croton—Brown, per M.	10 00 a 11 00
" Dark	11 00 a 12 00
" Red	12 00 a 13 00
Philadelphia	— — a — —
Trenton	21 00 a 22 00
Baltimore	38 00 a — —
Clark's Ottawa White	25 00 a — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	25 00 a 26 00
" Glengarnock	24 00 a 24 50
" Eglinton	24 00 a 24 50
" American, No. 1	27 00 a 28 00
" American, No. 2	23 00 a 24 00
" American, forge	21 00 a 22 00

	Store prices.	Cash.
Bar, Swedes, ordinary sizes	— 6 a	— 6¼
Bar, Swedes, nail-rod	— 6½ a	— —

LEAD—PER 100 POUNDS.

*German	— — a — —
*English, common	— — a — —
*Spanish	5 75 a — —
*Foreign, refined	— — a — —
*Bar	6 50 a — —
*Sheet	7 50 a — —
*Pipe	— — a — —
*Domestic	4 63 a — —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 00 a 3 10
8d and 9d, common	3 25 a 3 35
6d and 7d, common	3 50 a 3 60
4d and 5d, common	3 75 a 3 85
3d and 4d, light	4 50 a 4 60
3d, fine	5 25 a 5 35
2d, fine	5 25 a 5 35
Cut spikes, all sizes	3 25 a 3 35
Clinch nails, 1½ to 1¾ inch	5 25 a 5 65
do. 2 to 2¼ inch	5 00 a 5 35
do. 2½ to 2¾ inch	4 75 a 4 85
do. 3 inch and longer	4 50 a 4 60

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	6 75 a 7 00
*I. C. coke, 10x14	5 50 a 6 00
*I. X. charcoal, 10x14	8 75 a 9 00
*I. C. charcoal, 14x20	6 75 a 7 00
*I. X. charcoal, 14x20	8 75 a 9 00
*I. C. coke, 14x20	5 50 a 6 00
*I. C. coke, terne, 14x20	5 50 a 5 75
*I. C. charcoal, terne, 14x20	6 00 a 6 25

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 7⅝ a — 7¾
Sheet, (open)	— 8 a — 8½

SOLDERS.

No. 1	— 12½ a — 13
No. 2	— 11 a — 12

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 a 1 00
Berlin Freestone, in rough	— 75 a 1 00
Berea Freestone, in rough	— 75 a 1 00
Brown-Stone, Portland, Conn	1 30 a 1 35
Brown Stone, Belleville, N. J	1 00 a 1 35
Granite, rough	— 60 a 1 25
Canaan Marble	1 25 a 1 50
Dorchester, N.B., Stone, rough, per foot	— — a 1 00

PAINTS.

*Carmine, American, per lb. gold	7 00 a 7 25
Chalk, per 100 lbs	— 35 a — —
China Clay, per ton gold	18 00 a 20 00
Chrome yellow, dry, per pound	— 12½ a — 28
Lead, red American, per pound	— 8 a — 9
Lead, white American, pure, in oil	— 8½ a — 9
Lead, white American, pure, dry	— 7¾ a — 8¼
Lead, white English, pure, in oil gold	— 9½ a — 10½
Litharge	— 7½ a — 8
*Ochre, Fr., dry, per 100 lbs	1 50 a — —
Ochre, ground, in oil, per lb	— 6 a — 15
Ochre, Vermont, per 100 lbs	— 75 a 1 00
*Orange Mineral, English gold	— 9½ a — 10
Paris White, American	— 1½ a — 1¾
Paris White, English, prime	— 2 a — 2¼
Paris Green	— 15 a — 28
Plumbago paint, patent, per lb	— — a — 25
Putty, per lb	— 2½ a — 3
Spanish Brown, dry, per lb	— 1⅛ a — 1¼
Spanish Brown, ground in oil, per lb	— 8 a — 9
Venetian red, per cwt	1 75 a 2 00
*Vermilion, Chinese, per lb	— 85 a — 90
*Vermilion, Trieste	— 70 a — 75
*Vermilion, quicksilver, bags gold	— 60 a — 62½
Vermilion, American, common	— 15 a — 18
Whiting, per 100 lbs	— 60 a — 80
Zinc, white American, dry, No. 1	— 5 a — 7½
Zinc, white American, No. 1, in oil	— 8 a — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¾ a — 9
Zinc, white French, in oil gold	— 10 a — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 a 4 00
Coach Body	2 35 a 3 50
do do	1 80 a 2 00
Furniture	1 25 a 2 50
Black Asphaltum	1 00 a 1 50
Brown Japan	1 00 a 1 20
Liquid Paint Dryer	1 35 a 1 75
Harness, (black)	3 00 a 4 50
Shellac, Spirits	3 00 a 3 50

CEMENT—PER BARREL.

Portland (imported)	2 60 a 2 85
Portland (American)	2 25 a 2 50
Portland (Spanish)	2 50 a 2 75
Portland (Lafarge)	3 20 a 3 40
Portland (German, Bonner)	2 85 a 3 25
Lime of Teil	2 20 a 2 30
Lime of Teil, per ton	15 00 a 18 00
Roman	2 75 a 3 25
Keene's & Martin's, coarse	6 00 a 6 50
" fine	10 50 a — —
Rosendale	— 80 a — 85

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb. — 1¼ a — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16 a — 18
Goat, " "	— 21 a — 25

SLATE.

Purple roofing slate, per square	$6 00 a 6 50
Green slate	7 00 a 7 50
Red slate	10 50 a 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 a 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 a — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50 a 4 00
Nova Scotia, blue	3 50 a 3 75
Calcined, Eastern and city, per bbl	1 25 a — —
Calcined, city casting	1 50 a — —
Calcined, city superfine	1 75 a — —

LIME—PER BARREL.

State, common	— 70 a — —
" finishing	— 90 a 1 05
Rockland, common, cargo rate	— 90 a — —
" finishing	1 00 a — —
Ground	— 80 a — 90

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 a — 28
St. Domingo, crotches, fine	— 20 a — 30
St. Domingo, logs, small	— 5 a — 8
St. Domingo, logs, large	— 8½ a — 14
Frontera, Mexican, large	— 9 a — 12½
Frontera, Mexican, small	— 6 a — 8
Other Mexican	— 6 a — 12½
Honduras	— 6 a — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ a — 4½
Rio Janeiro, good to fine	— 5 a — 8
Bahia, ordinary to good	— 2½ a — 4½
Bahia, good to fine	— 5 a — 8
Honduras, per ton	10 00 a 20 00
Satin Wood, per foot	— 15 a — 25
Tulipwood, per lb	— 6 a — 7
Lignumvitæ, large, per ton	25 00 a 50 00
Lignumvitæ, other sizes	10 00 a 20 00

CEDAR.

Cuba, per superficial foot	— 8 a — 11
Mexican, small	— 8 a — 9½
Mexican, large	— 10 a — 11
Florida	— 40 a — 75

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

REVIEW OF THE MARKETS.—In the lumber market the past month business has been without animation, but the quiet and steady progress which has been going on for some months past, has continued toward a solid and healthy basis. With very few exceptions, dealers have been very poorly stocked in both quantity and assortment, considering the near approach of fall.

In the brick market there is not much change to note since our last report. The arrivals have been steady, with the supply at times selling closely, and even leaving a few buyers out, and on the other hand occasionally overrunning and causing a surplus of a few cargoes. With these changes there has been small fractional fluctuations on values, but always within the range of former quotations, and the position may be called steady.

In the lath market business has been unsettled. There has been a comparatively small product, with an indisposition to ship on the part of manufacturers, notwithstanding indications of a full average consumption. This condition of affairs has stimulated prices, and at this writing $1.65 is the ruling quotation.

In the lime market business has been in good condition, the sale of supplies having been full enough to prevent an accumulation, and former rates have been obtained. Offerings have not been very large, and manufacturers have still continued to complain of the rates current.

In the hardware market business has been fair, and on the increase for most of the leading styles of domestic hardware. A great many, however, are found who are dissatisfied with the condition of business, and indulge in somewhat unfavorable reports of the general situation. Supplies have been ample, but, as a rule, available only at full former rates, the tone ruling very firm.

In the paint market business has been unsettled, and not altogether satisfactory. As a general thing, however, the selling interest have regarded the situation as encouraging, and the expectations are that the distribution of supplies will be full this fall, and at fairly remunerative returns on all staple grades.

In the metal markets, American pig has been selling very well, and while commanding full rates readily, no active advances have been attempted. The home producer is afraid of foreign competition if prices go much higher, as a great deal of imported stock is only waiting the opportunity to unload upon this market. Scotch pig has been quiet, but parcels offered a little "off," both from pier and to arrive, found customers to quite a fair extent. Manufactured iron met with a better and more general sale, and prices appear on the turn for higher ranges. Domestic pig lead has sold quite freely, but of late the demand has slackened somewhat, and the market at this writing shows a quiet tone. Tin in pig has found more or less irregularity under speculative manipulation, both here and abroad, but the actual call for consumption has not been very heavy. Tin plates have been steady.

Stead's Improved Steam Generator.

About three years ago we were called upon by Prof. Thurston to witness the scientific test of a new steam generator, the invention of Mr. James C. Stead, who for many years has been experimenting in order to cause a thorough boiler circulation to prevent contraction and expansion, and to secure economy of fuel. Before putting in one of these generators in Faber's Pencil Works at Greenpoint, they had used three 40-horse boilers; but since making this test, Mr. Stead has made some additional improvements, and now the Fabers are running their entire works with one generator, and are doing more work than they did with the three previously employed. Having occasion to visit the above-mentioned works recently, we had the pleasure of examining the improvements made by Mr. Stead, and in our October issue we will publish illustrations of the generator as improved, with a full descriptive article.

A Remarkable Clock.

There has been for some time on exhibition at 733 Broadway, this city, a remarkable clock, made by Mr. Felix Meier, which has received the highest encomiums from horological experts and the technical journals, as a masterpiece of human ingenuity. The following brief description will give a general idea of this remarkable piece of mechanism, which is affirmed to rival and even surpass the great clock in the Strasburg cathedral:

The clock is 18 feet in hight, 8 feet wide by 5 feet deep, and weighs 5,000 pounds. There was required in the construction of the clock 2,000 wheels, besides the great number of shafts, pinions, and other machinery necessary to complete the grand combination. The clock is run by weights which weigh 700 pounds, and is wound up once in twelve days. The case or exterior of the clock is entirely of black walnut, and is elegantly carved or engraved in designs appropriate and symbolic of our Republic. Above the main body of the clock is a marble dome, upon which Washington sits in his chair of state, protected by a canopy which is surmounted by a gilded statue of Columbia; on either side of Washington is a colored servant in livery, guarding the doors, which open between the pillars that support the canopy; on the four corners of the main body of the clock are black walnut niches containing human figures, emblematic of the march of life; the two lower ones are supported by two female figures with flaming torches; one of the niches contains the figure of an infant, the second the figure of a youth, the third of a man in middle life, the fourth of an aged graybeard, and still another, directly over the center, contains a skeleton, representing Father Time. All of these figures have bells and hammers in their hands. The infant's bell is small and sweet-toned; the youth's bell larger and harsher; the bell of manhood strong and resonant; that of old age diminishing in strength, and the bell of the skeleton deep and sad. A figure of William Cullen Bryant, and another of Prof. Morse, inventor of telegraphy, rest upon the pillars that support the planetary system.

When the clock is in operation, it shows local time in hours, minutes and seconds; the difference in time at Chicago, Washington, San Francisco, Melbourne, Pekin, Cairo, Constantinople, St. Petersburg, Vienna, London, Berlin and Paris; the day of the week, calendar day of the month, month of the year, and seasons of the year; the signs of the zodiac, the revolutions of the earth on its own axis, and also around the sun; the revolutions of the moon around the earth, and with it around the sun; also the moon's changes from the quarter to half, three-quarters, and full; the correct movements of the planets around the sun, comprising Mercury, which makes the revolution once in 88 days; Venus, once in 224 days; Mars, once in 686 days; Vesta, once in 1,327 days; Juno, once in 1,593 days; Ceres, once in 1,681 days; Jupiter, once in 4,332 days; Saturn, once in 10,758 days; Uranus, once in 30,688 days. There is, therefore, a movement in this wonderful piece of machinery which cannot regularly be repeated more than once in 84 years.

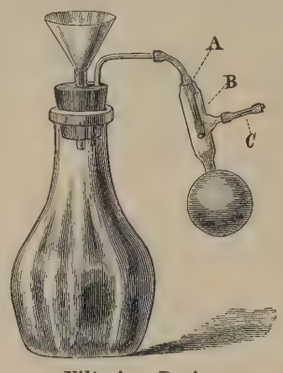
At the end of every quarter hour the infant in his carved niche strikes with a tiny hammer upon the bell which he holds in his hand; at the end of each half hour the youth strikes; at the end of three-quarters of an hour the man; at the end of each hour, the graybeard, and death then follows with a measured stroke to toll the hour. A carved figure projecting from either side of the skeleton indicates that time flies.

A large music-box begins to play at the same time that the skeleton strikes the hour, and a surprising scene is enacted upon the platform beneath the canopy. Washington slowly rises from his chair to his feet, extending his right hand, presenting the Declaration of Independence; the door on the left is opened by the servant, admitting all the Presidents from Washington's time, including President Hayes. Each President is dressed in the costume of his time. The likenesses are admirable. Passing in file before Washington, they face and raise their hands as they approach him, and, walking naturally across the platform, disappear through the opposite door, which is promptly closed behind them by the second servant. Washington retires into his chair, and all is quiet, save the measured tick of the huge pendulum and the ringing of the quarter hours, until another hour has passed.

A Device for Assisting Filtration.

A method for assisting filtration, which we illustrate in the accompanying engraving, is described by Mr. D. Anson Partridge in a late number of the *American Journal of Pharmacy*.

The essential part of the device is a glass tube A B C, about 3 inches in length and $\frac{3}{8}$ of an inch in internal diameter. At A the tube is drawn out tapering to make an air-tight fit on a rubber tube, which is passed into it, the tightness of the joint being insured by inserting a short piece of glass tube of proper size in the tube at A. The lower end of the rubber tube is closed by inserting a short piece of glass rod; the other end fits tightly over a bent glass tube communicating with the filtering flask. A smooth slit, about $\frac{3}{8}$ of an inch long, is cut in the rubber tube at B, as recommended by Bunsen, to act as a valve. The glass tube is also provided with a short arm, projecting from it at right



Filtering Device.

angles. This arm is closed by means of a short piece of rubber tubing, fitted at the end with a piece of glass rod, and provided likewise with a similar Bunsen valve at C. At its lower end the glass tube is drawn out tapering, to adapt it to receive a hollow rubber ball about 2 inches in diameter. This attachment, with the funnel to receive the filter, is adapted to the filtering flask by means of a tightly fitting rubber stopper.

By compressing the rubber ball in the hand, the valve at B closes and the air it contains is ejected through the valve at C. On removing the pressure from the ball, valve C closes by atmospheric pressure, leaving a partial vacuum in the ball; air passes from the flash through valve B into the ball, to restore the equilibrium, and a partial vacuum is created in the flask, which is increased by a second squeezing of the ball. The liquid material in the filter, in consequence, will be rapidly forced into the flask by atmospheric pressure on its surface. The contriver of this very practical device, states that when it is adapted to a pint flask, it will, with a few compressions of the ball, afford a pressure equivalent to a column of water 8 to 10 feet high.

We are indebted to the courtesy of the above named journal for the use of the engraving illustrating this apparatus, which will no doubt be found to be a good substitute for a Bunsen filter pump, where the latter cannot be conveniently rigged up in a laboratory.

CRYSTALLIZED MAGNESIUM.—M. Descloiseaux reports in the *Comptes Rendus* of the French Academy, the results of his examination of some beautiful crystals of metallic magnesium, which were presented to the Academy by M. Dumas. The latter obtained these crystals by the process of sublimation. They are described as being brilliant and of the color of silver. The faces were often curved and the edges blunt. The form of the crystal was usually that of a hexagonal prism terminated with the basal plane, the edges of the latter being truncated by the faces of a hexagonal pyramid. The basal plane is said to be a little less brilliant than the lateral faces. The crystals are malleable and sectile, but cleavage is absent. We find, however, no allusion to the size of the crystals.

How Spools are Made.

The town of Drummondville, Canada, on the St. Francis river, had the good fortune some years ago to be selected as the site of several factories for the manufacture of spools, the principal reason for the selection being the abundance of white birch-wood in its immediate vicinity. This wood, though inferior for many purposes, is just the thing for spools; and in consequence quite a thriving industry in this line has grown up. The following account of the process of manufacturing these useful articles may be of interest.

The wood, after being delivered to the factories, is first sawed into pieces about 4 feet long and from 1 to $1\frac{1}{2}$ inches square, according to the size of the spool it is desired to make. These pieces are put into a dry-house and thoroughly dried, from whence they are taken into the factory and given to the rougher, who, in an incredible short space of time, bores a hole in the center a couple of inches deep, turns about the same space round, and then cuts off the length required for a spool. The machines used for this purpose are revolving planers, in the center of which is a revolving gimlet or bit, and immediately to the right a small circular saw with a gauge set to the proper size for the spools. The roughers receive $1\frac{1}{2}$ cents per gross for their work, and experienced men can turn out from 100 to 130 gross per day. The round blocks pass from them to the finishers, who place them in machines which give them the shape of spools, and make them quite smooth. The spools are thrown loosely into a large cylinder, which revolves slowly, so that the spools are polished by the constant rubbing upon each other for some time. On being taken out of the cylinder, they are placed in a hopper with an opening at the bottom, through which they pass down a slide for inspection. Here the inspector sits and watches closely to see that no imperfect spools are allowed to pass, and a very small knot or scratch is sufficient to condemn them. They are packed in large boxes, made the proper size, and no additional packing is needed. The packers receive $\frac{1}{4}$ of a cent per gross for packing, and a smart boy who is accustomed to the work can pack about 200 gross per day. One proprietor ships over 2,000,000 spools per month to England, and another firm ships over 1,000,000 spools to Glasgow, Scotland.

Street Lamps Extinguished by Atmospheric Disturbance.

The New York *Gas-Light Journal* gives some interesting particulars in regard to a singular atmospheric disturbance which was noticed in and near this city on the night of the 16th of April last. A large number of street lamps were extinguished, without any apparent cause, until observations showed that a very important atmospheric disturbance was registered by the self-recording pressure-gauge instruments. It appears that the pressure-gauge registers showed a very decided rise and fall of pressure at about 11.45 P. M. In some cases the pressure fell first and then suddenly rose, while in others it rose first and then fell—the extreme variation was 16-tenths. At the same time, the self-registering barometer at the Meteorological Observatory showed a corresponding disturbance in the atmospheric pressure. In a number of cases street lights were extinguished in certain localities; but the disturbance seemed to be confined to a belt extending from the Orange mountains, through Newark and Jersey City, and across Manhattan Island to Long Island. It is important to record this fact, for the reason that it accounts for the extinction of street lamps, in this case at least, when, if it were not for the well-established fact of the atmospheric disturbance, it would have been very difficult to do so.

Home Department.

Commercial Honor.

There are a class of men doing business who pride themselves on their commercial honor. That is to say, they value their pledged word above any money consideration that can be accorded them, and it is often said of them that "their word is as good as any other man's bond." When a merchant has attained this elevated position in the commercial world, he can go no higher, he can command no greater respect, he has secured for himself the most enviable position to which any man can aspire. How often do we hear the remark, such a firm "are gilt-edged—they are good for all they contract for."

A man, who, having made a bad bargain in buying, for instance on a falling market, and seeks no excuses for the non-fulfillment of his contract, but swallows his losses with a good grace and pays them with the last dollar at his command, is a thoroughbred, and the embodiment of commercial honor. Such a man can never be kept down, for his credit is unimpeachable, and when he desires business favors he gets them, for "he never was known to go back on his word."

There are, however, we are sorry to say, another class of business men who never rank any higher than mere money-makers. Their sole aim and object in life is to accumulate riches, and if they happen to get caught with a bad contract on their hands, they are fraught with subterfuges to avoid the payment of their honest debt. It is enough for them that the payment of this debt involves a loss, and putting aside all sense of honor and manhood, they crawl under the shadow of their perjured word and ignore any contract that has not their dishonored name signed to it in full.

Men there are who condescend to argue, explain, and lastly, quibble about legal technicalities, and fairly wallow in the filth of their dishonesty for the sake of the few dollars involved in a transaction of their own seeking. There is nothing outspoken, open and aboveboard with such men. They deal in promises, which, if not found fruitful to their profit, they will fit them to a meaning entirely opposite to the one previously implied, and chuckle over the saving in dollars and cents bartered for their self-respect.

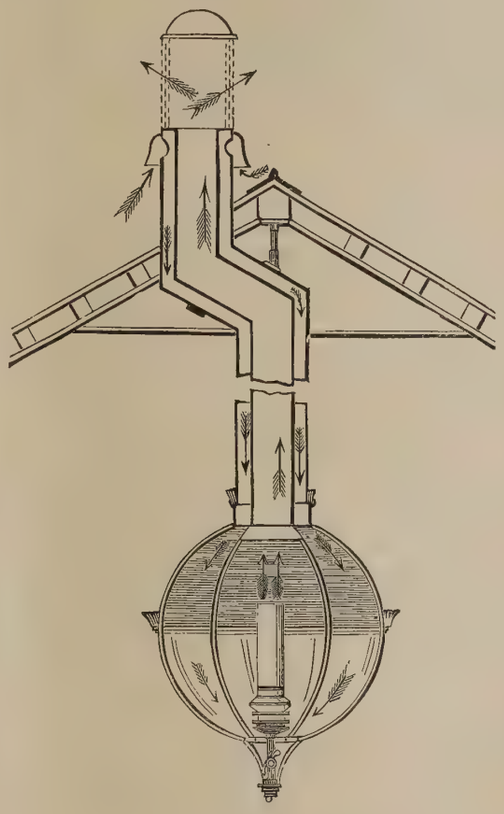
A man's good name never deserts him, while riches, obtained through fraud and dishonesty, after proving a curse and a source of misery, usually take unto themselves wings and fly away.

Physical Education.

Absolute health is only attained when the body is equally developed in all its organs and members. The man with muscles of steel and a diseased heart cannot be said to be in good health, and diseases of stomach, heart and nervous system are often—it may be said usually—produced by that system of development known as training. At a recent rowing match in Philadelphia, two plucky lads in contesting boats fainted as soon as the race was over. Their condition, which was apparently good, was actually abnormal, and their systems gave way because the strain which their muscles met was too great for their vital functions. Lately a similar but more serious calamity occurred at Sag Harbor. A Brooklyn lad, who had taken part in a pedestrian contest, when removed from the track, fell down dead. He had prepared himself for walking and running, and depleted his vital organs to build up his limbs. When the strain came, the impoverished and most important part gave way. The severe muscular exercise of college athletes has carried off many fine young men by consumption, heart disease and other disorders, directly traceable to the absurd overwork required of their bodies. There is a limit of human endurance. That limit is reached when the body is impaired in one quarter to benefit special organs. The severity of the test by which athlete prizes are won, seems designed rather to award the laurels to him who is least healthy, because more unevenly developed, than to the really best man.

An Ingenious Self-Ventilating Light.

There has of late been much discussion as to the cause of the deterioration of book-bindings after some years of storage on library shelves, and the question has not yet been definitely settled whether this deterioration is the natural result of imperfect methods of tanning the leather, or whether it is due to the injurious action of sulphurous gases given off in the combustion of coal gas used for lighting the rooms. Sulphuric acid has been detected in small quantities in such bindings, and its presence would be a sufficient explanation of the deterioration of the leather; but either of the causes above named would account for its presence. The question requires more investigation before it can be definitely settled.



Self-Ventilating Light.

Meanwhile, Mr. Sugg, a well-known English gas engineer, and the inventor of numerous improvements in gas-burners, has devised an excellent form of self-ventilating lamp or burner for use in libraries and other places where it is important or desirable that the products of combustion shall be removed from the room, that the atmosphere may not be vitiated. A glance at the accompanying engraving (for the use of which we are indebted to the *Sanitary Engineer*), will show how effectively this object is accomplished. The lamp proper is a glass globe, the lower half being clear, and the upper half of white glass. The burner is of the Argand pattern as improved by Mr. Sugg, and gives a light of from 100 to 200 candles. As shown in the cut, the lamp is connected with a double flue passing through the roof of the apartment, the inner one to carry off the products of combustion, and the outer one to supply fresh air to the burner. The action of this flue and the direction of the currents is shown by the arrows. The lamp is provided with a pair of curved reflecting plates, by which the fresh air is fed into the base of the burner; the lamp is entirely closed at the base, and receiving its entire air supply from the flue, it is independent of the atmosphere of the room, and neither robs it of oxygen nor vitiates it by its combustion products. The cold air descending the outer flue, likewise exercises a cooling influence, and, according to Mr. Sugg, his device will not raise the temperature of the room 1° Fah., notwithstanding its intense light-giving powers. It is further added, that where it is desired, the outer chamber can be dispensed with, and the air supply for feeding the burner taken from the room through openings provided for the purpose at the base, as is usually done.

From this description, our readers will observe that this lamp is excellently adapted to serve the purpose for which it is designed, and that its utility is by no means confined to library rooms, but for all apartments, large or small, where the vitiation of the atmosphere from the burning of numerous gas jet or lamps is objectionable. The principle of the closed lamp is not unlike that of the well-known tubular lantern of Mr. Irwin, with which most of our readers will be familiar.

What is a Cold?

On a less authority than the London *Lancet* would the theory be credited, that the resolve of a person not to take a cold is ample protection against having one? "It is startling to discover," says the *Lancet*, "how little we know about the commoner forms of disease. For example, a 'cold.' What is it? How is it produced? and in what does it consist? It is easy to say a cold is a chill. A chill of what part of the organism? We know by daily experience that the body, as a whole or any of its parts, may be reduced to considerably lower temperature than will suffice to give to man a cold if the so-called chill be inflicted upon the surface suddenly. It is then the suddenness of a reduction of temperature that causes the cold? It would be strange if it were so, because few of the most susceptible of mortals would take cold from simply handling a piece of cold metal or accidental contact with ice. The truth would seem to be that what we call cold taking, is the result of a sufficient impression of cold to reduce the vital energy of nerve centers presiding over the functions in special organs. If this be the fact, it is easy to see why nature has provided the stimulus of a strong fit of sneezing to arouse the dormant centers and enable them at once to resume work and avoid evil consequences. This explains why the worst effects of cold do not, as a rule, follow upon a 'chill' which excites much sneezing. Shivering is a less effective convulsion to restore the paralyzed nervous energy, but in a lower degree it may answer the same purpose. The shivering that results from the effect of a poison on the nervous centers is a totally different matter. We speak only of the quick muscular agitation and teeth chattering which occur whenever the body is exposed to cold and evil results do not ensue. It follows from what we have said, that the natural indication to ward off the effects of a chill is to restore the vital energy of the nerve centers, and there is no more potent influence by which to attain this object than a strong and sustained effort of the will. The man who resolves not to take cold, seldom does."

Help the Children Grow Erect.

William Blaikie, author of "How to get Strong, and how to Stay So," spoke before the Brooklyn Teachers' Association recently on "Physical Education." "I want," said he, "to see if in an informal talk we cannot hit upon some way in which we can bring the physical education of school children down to a practical basis. Our children, who are healthy and buxom when they begin school-work, come out pale, sickly and with round shoulders. If you require the children under you to sit far back on a chair and to hold their chins up, you will cure them of being round-shouldered, and the lungs and other vital organs will have free and healthy play. Another simple plan is to have the

children bend over backward until they can see the ceiling. This exercise for a few minutes each day will work a wonderful transformation. If a well qualified teacher could be employed to superintend the physical development of the children, the best results would be seen."

Laying and Nailing Floors.

The fact (says the *Mechanic*) that the floors of buildings are scarcely secondary in importance, as a feature of strength, their being properly nailed becomes a material matter for consideration. No one who understands the science of construction, will undertake to question the values of floors in building as a means of bracing and stiffening, either in brick or frame construction. And this fact being admitted, the question of the best method of laying and nailing them becomes important. Yet there is no portion of the work, as a rule, more carelessly executed, except where care becomes an obligatory and imperative necessity in special cases. To lay floors properly, they should fill out snugly to the walls at all parts. The more solidly this is done, the more complete will be their bracing effect. Every piece of timber used in a building has a proportionate strengthening value, and that value is increased or diminished by the manner in which each piece is applied and secured. Every single nail driven is one part of the general strength obtained, although one nail is very insignificant considered in connection with the thousands used in a building. One, or two, or a hundred may be omitted, and apparently no harm result; but still their support and strength, whatever that might be, is taken from the whole. This is particularly applicable to the nailing of floors. Each and every floor-board should not only fit snugly at the walls, and the joints be driven up solidly, but they should be nailed with two nails at each and every nailing, driven from the face, or "through-nailed," and the nails set in with a nail-set. This is the best method of nailing floors, with a view to their solidity; and when so laid and nailed, the full strength of the flooring is obtained, and their entire value secured, as a principle of strength, as well as their utility. This "through-nailing" proposition will, however, be met with the argument that "it makes many holes in the surface, and detracts from the neat appearance of the face of the floor." But the argument is valueless, except on ball-room, kitchen, and other similar floors, not intended to be covered by carpets, oil-cloths, etc. No argument is possible that through-nailing does not give greater strength and solidity. These are fixed facts, and if so, then the method of through-nailing is the better in all cases where floors are covered, as nail holes do no injury and are unseen when covered up.

The "tongue," "blind," or "secret-nailing" process was unknown in the boyhood days of those who have lived half a century, and when first adopted the nails were driven into every timber, with due regard to the angle at which they were driven, and the heads of the nails were not bruised into the wood, but when sufficiently driven by the hatchet or hammer to touch the wood, a nail-set was used to complete the driving, and many a journeyman received his discharge and boys were reprimanded for driving the nail too far and bruising the edge of the flooring. But of late days the nails are banged into the wood, without any regard to the bruising of edges, and not much in reference to the angle at which driven, although the proper slant of the nail is of the highest importance. The nearer possible perpendicular they are driven, the greater the draw, and the more solid will be the floors. But often they are forced in at so flat an angle that many of them bolster up the boards, and the result is a disagreeable, creaking sound in walking over the floors, with very little strength from the nailing. There would be less objection to concealed nailing if proper care were practiced. But it is a more acceptable method to "floor-layers," as a greater number of squares can be laid within working hours; and if there is no one watching, and the work is being done "piece-work," it is an easy matter for the workman to omit one-fourth or one-third of the nails, and no one be the wiser after the following board is driven up. The labor of secret-nailing is not more than one-fourth that of driving two nails from the face and setting them in with a nail-set. In wide flooring, concealed nailing is by no means good, even if carefully performed; and as far as strength to the building from the floors and their solidity are concerned, by two through or face nails in each and every board at each nailing-place, it is much more than doubly increased. As before remarked, in uncovered floors the secret-nailing provides a more perfect face, and this is the only recommendation for this system of nailing.

Two Kinds of Inspection.

The MANUFACTURER AND BUILDER has for years been urging upon steam-users the necessity of a searching and periodical internal and external examination of their steam boilers by practical experts, being fully alive to the knowledge that safety in the use of steam can only be insured by constant vigilance, supplemented by intelligent inspection.

The case of the "Seawahnaka," which was provided with her certificate of government inspection, is the latest illustration of many that have preceded, of the fact that either the methods adopted by the government officials in their examinations are radically defective, and insufficient to insure safety, or that the manner in which they are conducted is careless in the extreme. It is probable, from the showing of statistics of governmental as compared with private inspection, that both of these causes contribute to the unfortunate record of government inspection. A comparison of the records of the inspections of the United States Board of Supervising Engineers with those of the Hartford Steam Boiler Inspection and Insurance Company, afford the most striking and instructive demonstration of the failure of government methods as practiced, while it serves, by contrast, to bring out in more striking colors the triumph of the methods and practice of the Hartford Steam Boiler Inspection and Insurance Company. We give below a summary of the work of the United States government inspectors for a period of eight years, as compared with that of the Hartford company. Those of our readers who desire the details of this comparison, will find them in our issue for January, 1879. The comparative results alone concern us here, and they are as follows:

United States Board of Supervising Engineers.

Total No. of boilers tested	42,473
Total No. of lives lost by explosion	667
Total amount of property destroyed by explosion	$623,514

Hartford Steam Boiler Inspection and Insurance Co.

Total No. of boilers examined	56,145
Total No. of lives lost by explosion (in 12 y'rs)	25
Total amount of property losses	$74,381

Let these figures speak for themselves as to the comparative merits of the two systems. The Hartford company can stand by its record.

Miscellaneous and Advertising.

A Boston man has patented a plan for utilizing the heat developed by the motion of street car-wheels, to warm the feet of the passengers.

The George Place Machinery Agency, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

Rupture bands made to order. Single, $2.25; double, $3.50. Best material and workmanship. Send for circular. L. F. de Lesdernier & Co., 166 Greenwich street, New York.

The Hazard Manufacturing Company, of Wilkesbarre, Pa., are well employed on orders for wire rope of various sizes, and intend soon to go extensively into the manufacture of galvanized wire for telegraphic purposes.

James Leffel & Co., of Springfield, Ohio, were the pioneer manufacturers of water-wheels in this country, and since they began to make them, they have been improving their construction, until now they give the best results of any wheel in use. Although many competitors have come into the field, the "Leffel" has not only kept pace with the best, but surpassed them in competitive tests.

With all our boasted advance in the modern plumbing of our houses, there is a sad lack of attention paid to proper overflows to our wash-basins, the old style of making a few holes in the side of the basin being still deemed sufficient for any emergency, and if the truth were known, it would be found that very little was thought about the matter at all. The most perfect, and, in fact, the only one we know of that answers the conditions of a proper overflow, is the "Wellington," manufactured by C. E. Robinson & Co., at 61 Beekman street, this city. This overflow not only performs its duties as such, but offers a positive security again sewer-gas.

Among the many kinds of wood-working machines made by J. A. Fay & Co., of Cincinnati, Ohio, may be mentioned the following: Patent universal and variety wood-workers; planing, matching and beading machines; improved surfacing machines; outside and inside molding machines; mortising and boring machines; shaping and edge-molding machines; tenoning and dovetailing machines; band and scroll saws; rip, cross-cut and edging saws; band and circular re-saws; shingle saws; self-oiling saw arbors; hand and power sand-papering machines; horizontal and vertical boring machines; blind-slat tenoners; blind wirers; shafting, hangers and pulleys. Not satisfied with the enviable reputation already earned, this firm are continually improving their manufactures, and introducing new machines embodying the results of the latest practice.

Design for a Farm House, Costing $2,500.

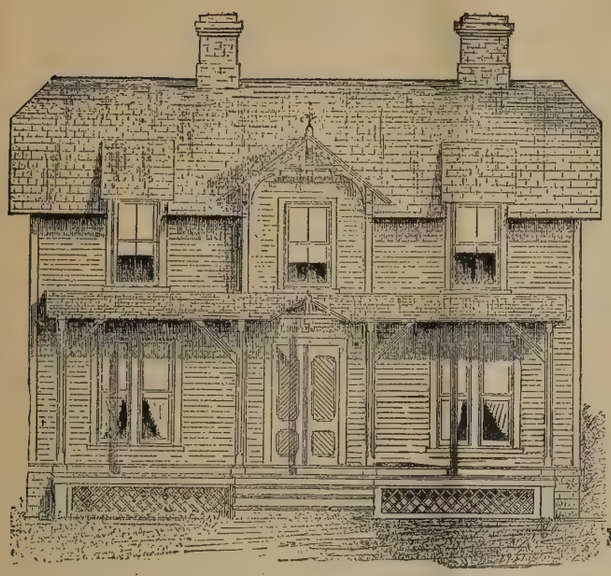
The design on the opposite page, shows in every respect a convenient and complete arrangement for a farm house, and by reference to the plans, it will be seen how well adapted the house is to its purpose. There are eight rooms. On the first floor, parlor, sitting-room, kitchen and dining-room; on the second floor, four bedrooms. These rooms are well supplied with closets, pantries, etc. Adjoining the kitchen, yet well separated from it, is a wood-shed, a convenience of arrangement that cannot fail to be appreciated.

The cellar is commodious, running under the entire building, and is divided into well lighted and ventilated milk-rooms, and ample storage room for fruits and vegetables. The cellar bottom is of concrete.

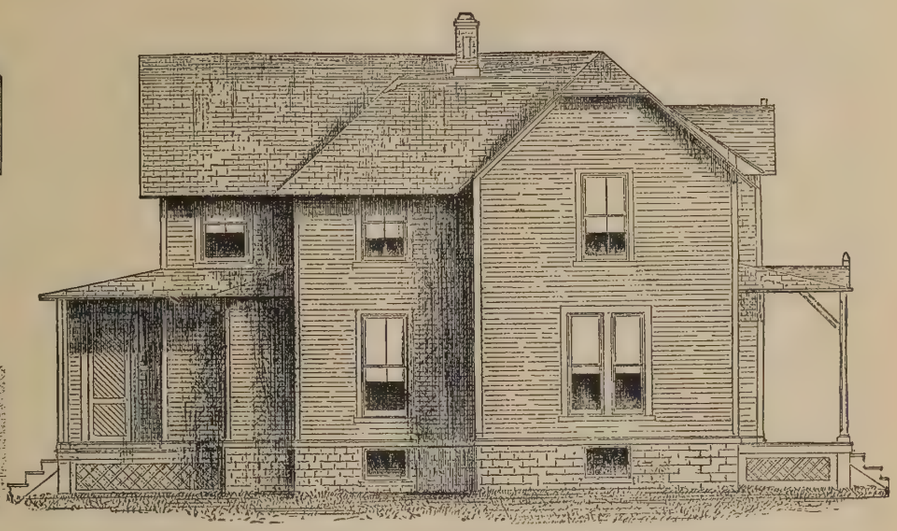
The timber used in the building is of hemlock, of the following scantling: Sill of frame, 4 × 6 inches; beams, 2 × 9 inches, set 16 inches to centers; girder in cellar, 6 × 8 inches; studs, 2 × 4 inches; posts, 4 × 6 inches; enterties, 4 × 6 inches; plate, two 2 × 9-inch studs well spiked together; rafters, 2 × 6 inches, set 20 inches to centers; ridge and valley rafters, 2 × 10 inches. The entire frame is enclosed with hemlock sheathing boards, and covered with 6-inch clapboards. All window-frames, water-tables, corner-boards, piazzas and cornices are of white pine of ordinary thickness, and as shown on design. The roofs are to be shingled. The flooring of the house is to be of white pine 4½ inches wide.

The interior walls and ceilings are to be plastered and hard finished. The kitchen is to be wainscoted with narrow beaded pine, with cap. The trimming throughout is to be 6-inch, with a 2-inch molding. Base 6½ inches high, with a 2-inch molding. The stairs are to be of pine, with newel, hand-rail and balusters of black walnut. The entire house, outside and inside, is to be painted in two coats.

This house, built in the neighborhood of this city, is estimated to cost $2,500. The architects are Messrs. Clarence W. Smith and Augustus Howe, Jr., of 7 Warren street, New York.



FRONT ELEVATION.



SIDE ELEVATION.

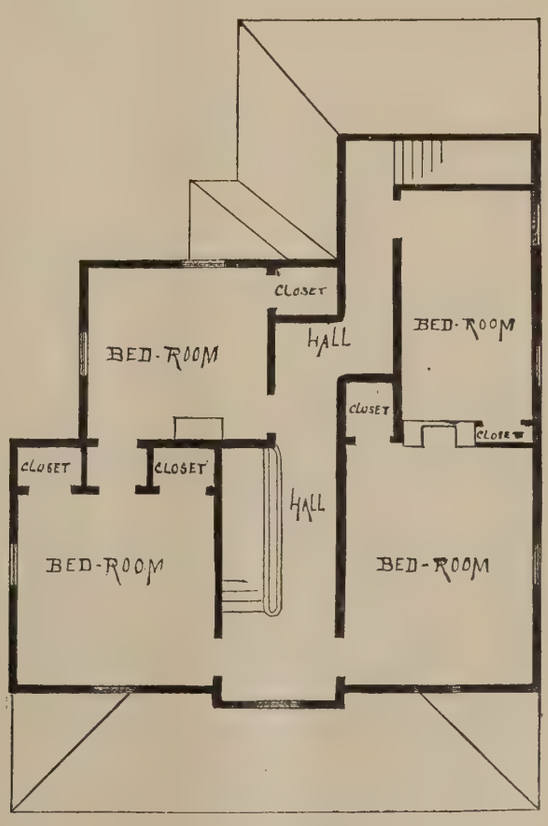
DESIGN FOR A FARM HOUSE,

COSTING $2,500.

Dimensions: Width across Front, 38 feet; Depth, 46 feet 6 inches.

First-Floor Plan.

Dining-Room...12 × 17.6 feet.
Sitting-Room...14 × 17 "
Parlor.....13.6 × 17 "
Kitchen.....13.6 × 15 "



Second-Floor Plan.

Chamber over Sitting-Room.....14 × 13.6 feet.
Chamber over Parlor.....13.6 × 17 "
Chamber over Kitchen..... 9.6 × 16 "
Chamber over Dining-Room..... 12 × 13 "

Where our Cereals are Grown.

The total product of cereals in the United States increased from 1,450,000,000 bushels in 1868, to 2,178,000,000 in 1877, and 2,302,000,000 in 1878. Of the whole national supply, only 3 per cent was exported in 1868, 10 per cent in 1878, while in the twelvemonth ending June 30th, 1879, the shipments reached the unprecedented figure of 246,000,000 bushels, or nearly 11 per cent of the entire yield.

The seat of corn production was formerly in the South. As late as 1859, fifteen slave States produced 52 per cent of the whole crop. In the year 1860, the corn-growing States were ranked as follows: Illinois, Ohio, Missouri, Indiana, Kentucky, and Tennessee; but ten years later Iowa had dislodged Ohio from the second place. In 1878 Illinois and Iowa retained the first and second ranks; Missouri and Kansas both passed Ohio, and then followed the other States mentioned in the same order as in 1860. The crop of all the Southern States was only 10,000,000 bushels larger in 1877 than it was the year before the war, whereas that of the other States had risen in the same period from 400,000,000 to 900,000,000 bushels. The center of production has moved, however, more rapidly westward than northward. Amid all these changes, the relative yield of the central belt between the Alleghanies and the Mississippi River has declined by very slow degrees, and will continue for a time to recede slowly, until the lands of the Missouri valley are more fully occupied. Already, however, the proportion of the corn crop grown in the trans-Mississippi zone reaches nearly 40 per cent.

Of our wheat crop, the Atlantic coast now produces only 17 per cent, against 30 per cent in the year before the war. The central belt has fallen in the same period from 54 per cent to 40 per cent, while the trans-Mississippi region has risen from 14 per cent to 42 per cent. The surplus is now produced only in five States lying between the Ohio river and the lakes, and in Minnesota, Iowa, Missouri, Kansas, Nebraska, California and Oregon. The portions of our own country requiring part of this surplus comprise New England, the Middle States, and the Cotton States. New England produces only three-tenths of a bushel for each inhabitant; the Middle States grow three and one-third bushels, or a little more than half the quantity necessary for a full supply; the Southern, Atlantic and Gulf States almost as much, while Kentucky and Tennessee, with nearly six bushels, are self-supporting.

While the westward progress of corn production has of late been very slow, the tendency of the wheat center to move westward is still active, and may continue so for many years, as wheat culture subdues the high plateaus and mountain valleys between the Missouri and the Pacific Ocean. For Washington Territory, for instance, from which maize-growing is virtually excluded, competent observers predict a yield of wheat, in the near future, three times as large as the present supply of California. Of Dakota, it is affirmed, on trustworthy authority, that the area especially adapted to wheat-growing, does not fall short of 40,000,000 acres. A considerable part of Wyoming and Idaho can be turned to account in the same direction; and even Montana, though better suited to grazing purposes, was computed by Prof. Thomas, of the Hayden expedition, to contain nearly 8,000,000 acres on which wheat could be raised. Counting but one-tenth of the intermontane region, which includes two States and six Territories, with four-tenths of the area of the Pacific slope on the west, and of Dakota on the east, we have upward of 160,000,000 acres of land, from much of which the growth of maize will always be debarred, but in which wheat-farming will ultimately exist as a specialty, dominating for a time over all other arable culture.

With such opportunities of expansion, it is plain that our wheat area cannot fail to supply any deficiency in the world's production for many generations, without stinting the requirements of our rapidly increasing population.

New Publications.

Pre-Adamites; or, A Demonstration of the Existence of Man before Adam; together with a Study of their Condition, Antiquity, Racial Affinities, and Progressive Dispersion over the Earth. With Charts and other Illustrations. By Alexander Winchell, LL.D., Professor of Geology and Paleontology in the University of Michigan. Chicago: S. C. Griggs & Co. Pp. 500. Price, $3.50.

In a general sense, this may be described as another "reconciliation" book, and this time from a man of some scientific eminence. We had thought that this sort of thing had been relegated to the theologians, who, by reason probably of long practice, have become so accustomed to "eating crow," that they have learned to take it without gagging; but the fact that a man of Prof. Winchell's prominence in the scientific world has essayed the Herculean task, lends special interest to his book. Its scope will best appear from the author's own statement.

"The central idea of the work," he says, "is human pre-Adamitism; all other views presented are subsidiary or collateral. The thesis implies that the characterization of Adam, in the document which has given us the name, is such that the name cannot be applied to the first progenitor of the human kind, and all the collateral statements either involve or permit the derivation of Adam from an older race. . . . We have now the facts of race histories, and the discovered laws of animal life, past and present, to summon to the support and sanction of this conclusion. I have not contented myself with the employment of the direct argument, but have attempted to show that the old hypothesis of the descent of the black races from Ham is equally unscriptural and unscientific. Finally, assuming the thesis proved, I have endeavored to gratify the natural and intelligent curiosity which expresses itself in the questions, Who, then, were the first men? Where did they appear? and how long since? How have the races come into existence? and what has been the method of their dispersion over the earth? These questions lead us to the very borders of the field of recognized facts, and even into the domain of speculation; but I hope I have in most cases presented views which coördinate the facts in a rational conception, if I have not enunciated conclusions which will stand the test of future investigation."

If we put out of sight the, to our mind, trivial purpose, or objective point, of Prof. Winchell's book, and look simply at its scientific features, we find it fully worthy of its distinguished author. From this standpoint, it is an admirable and valuable contribution to ethnological science, in which the reader will find a most instructive and interesting exposition of such questions as the origin, characteristics, distribution and antiquity of the human race. But that so rich a field of scientific learning should have been harvested for no better purpose than to endeavor to square the childish traditions of a barbarous nation with the ascertained facts of science, and by so doing to prop up the tottering walls of the antiquated and incongruous structure of ecclesiastical ethnology, which no amount of misdirected ingenuity can save from going utterly to pieces, belittles the talents of the author. This one purpose so constantly obtrudes itself throughout the book, that because of its very abundance of learning, its perusal constantly suggested to us the idea of a succession of passages from the sublime to the ridiculous, and forcibly brought to mind the story of the pious hawkers of Constantinople, of whom it is said, that they solemnly perambulate the streets, exclaiming: "In the name of the Prophet!—Figs!"

It would be unjust to the publishers to omit mention of the fact that they have spared no expense in getting up the book in elegant style. It is admirably printed on good paper, and is abundantly illustrated with original engravings showing typical race peculiarities, etc., and with several well-executed charts. The binding is in keeping with the mechanical excellence of the book, the production of which is highly creditable to the publishers.

The Engineer's Handy Book. Containing a full Explanation of the Steam Engine Indicator, and its Use and Advantages to Engineers and Steam-Users; with Formulæ for Estimating the Power of all Classes of Steam Engines; also, Facts, Figures, Questions, and Tables for Engineers who wish to qualify themselves for the United States Navy, the Revenue Service, the Mercantile Marine, or to take charge of the better Class of Stationary Steam Engines. With Illustrations. By Stephen Roper, Engineer. Philadelphia: E. Claxton & Co. 1881. 12mo, pp. 678. Price, $3.50.

Mr. Roper is well known to many of our readers as the author of a number of useful reference books relating to steam engineering, which have become deservedly popular by reason of their plain and intelligible style and their freedom from unnecessary and confusing mathematical technicalities. Mr. Roper's object in all these hand-books has avowedly been to present facts and explain principles in language so plain and comprehensible that average steam-users, engineers, firemen, and those who are usually found in charge of steam machinery, can read his books understandingly and with profit.

It is esteemed in some quarters *the thing* to sneer at books of the type of Mr. Roper's, but for our part we would be glad to see them largely multiplied and distributed in every workshop, for it is only out of books of this kind that the average workman will be able to master the principles of his handiwork. The present volume is no exception to this rule; on the contrary, we regard it to be decidedly the best of Mr. Roper's books, both with regard to its substance and the manner in which the same is classified and presented.

Mr. Roper modestly says, in his introduction, that his book is not written for the purpose of instructing engineers how to design and proportion steam engines and boilers, but rather how to take care of and manage them intelligently. The book will be found to treat of every subject which the engineer and steam-user will be likely to meet with in practice, the information being generally conveyed in a condensed and lucid paragraph. The chapter on the theory and use of the steam engine indicator will be welcomed by many engineers to whom the previously existing treatises on the subject were sealed books. While this hand-book will be found useful to all whose avocation necessitates a knowledge of steam and steam machinery, it will be found specially serviceable to those who design to qualify themselves for the engineering branch of the United States navy, the revenue service, or the mercantile marine, as the author gives the fullest information respecting the qualifications necessary for candidates, the character of the examination to be passed, indicates the most important subjects on which the candidate must prepare himself, and the like. Mr. Roper's book is in reality what he has named it—"An Engineer's Handy Book."

Mills' Directory of Manufactories, Boiler Owners and Steam Users in the New England States. First Edition. New York and Boston: The J. N. Mills Publishing Co. 1880.

This directory is the second of a series, the first having been confined to New York city and Brooklyn. The present work fully sustains the reputation of its predecessor, and in many respects is incomparably better, the result, no doubt, of experience gained in the publication of the first volume. The book is very complete, and, being arranged alphabetically by cities and towns, is very convenient for reference. Much useful information is given in addition, including rules for engineers and firemen. This directory should be in the hands of every steam-user in the country, and other parties wishing to reach that interest, will find the work invaluable.

A special notice is contained in the book before us, announcing the issue, on or about October 15th next, of a directory of manufactories, steam boiler and engine owners for the States of New York and New Jersey. The enterprising publishers will no doubt reap substantial returns from their useful service to the manufacturing community.

Cremation. By an Eye-Witness. New York: A. S. Barnes & Co. 1880. Price, 15 cents.

This unpretending little pamphlet, by an anonymous author, gives the experience of one who has witnessed the operation of cremating a human body, and who, from having strong prejudices against cremation, has become its warm advocate from the results of his personal observation. He discusses the whole question of cremation in a very sensible way, presents the arguments against its practice very fairly, and answers them very satisfactorily. We have seen it stated somewhere that the author of this brochure was "a Christian minister." This fact lends special interest to his views, since the objections to this method of disposing of the bodies of our dead emanate chiefly from gentlemen of his cloth. We heartily approve of the author's conclusions, and trust the pamphlet we review may make numerous converts.

Pocket Mining Atlas. Compiled from the latest Official Surveys and the most Authentic Sources. Edwin Bolitho, "Engineering and Mining Journal," New York. 1880. Price $1.

The above publication contains, in convenient pocket-book form, twenty-seven maps and plans, embracing all the districts of the country that are prominent producers of the precious metals, and giving the names and locations of the mines. It will be found to be a very useful pocket companion to every one who is interested in the purchase or sale of mining properties. Mr. Bolitho's prominent connection with the *Engineering and Mining Journal* is sufficient guarantee of the strict reliability of the work.

Bullion; its Production and Use. Compiled by the Editor of the New York "Bullion." New York: Bullion Publishing Company. 1880.

This work gives in convenient form complete and reliable statistics of the production and use of gold and silver, compiled from the columns of the *Bullion*. It will be found very serviceable for reference to matters pertaining to the statistical side of this interesting subject, and also as a guide on the subject of precious metal mining. The pamphlet contains also a number of articles on politico-economical and scientific subjects germane to its title, from eminent authors.

OTHER PUBLICATIONS RECEIVED.

Proceedings of the Engineers' Club of Philadelphia, Vol. I., No. 5. From the Club.

Annual Report of the Secretary of Internal Affairs of the Commonwealth of Pennsylvania. Part III. Industrial Statistics, Vol. VII., 1878-79. Harrisburg: State Print. 1880. From Hon. M. S. Humphreys, Chief of Bureau.

Summary Statement of the Imports and Exports of the United States for the month ended May 31st, 1880, and for the eleven months ended the same, compared with the corresponding periods of 1879. [Corrected to July 6th, 1880.] Washington, D. C.: Bureau of Statistics.

Wassergas als der Brennstoff der Zukunft. Strong's Patent zur Bereitung von Heizgas in Verbindung mit Lowe's Verfahren für Leuchtgas. Bericht von Julius Quaglio, Chef-ingenieur. Wiesbaden: Verlag von J. F. Bergmann. 1880.

Geological Survey of Kentucky, N. S. Shaler, Director. Chemical Report on the Soils, Coals, Ores, Iron Furnace Products, Clays, Marls, Mineral Waters, Rocks, etc., of Kentucky. By Robt. Peter, M. D., etc. Being Part 7, Vol. V. of the second series. From the Director.

American Natural Cement. By F. O. Norton. Reprint from the Proceedings of the American Society of Civil Engineers. Pamphlet. From the Society.

Healthy Homes for Rich and Poor. Reprint from the *Sanitary Engineer*. 1880. 12mo, pp. 16. From the publishers.

Correspondence.

COMBUSTION OF WOOD BY LIME.

On the subject of the combustion of wood by the slaking of lime, which was broached in our Query Department last month, we have been favored, through the interest taken in the subject by Mr. John C. Trautwine, the well-known engineer, with the following letter from Mr. Jas. F. Smith, for many years engineer of the Schuylkill Navigation Company, which contains some interesting facts. Mr. Trautwine's letter was written at our request. Only that portion of Mr. Smith's letter bearing on this topic is reproduced:

READING, PA., August 2d, 1880.

JOHN C. TRAUTWINE, ESQ.:

Dear Sir: . . . . Has asked me to reply to your favor of the 27th ult., relative to the ignition of wood by lime slaked in large quantities.

Of my own knowledge I have never known of any actual occurrence of the kind. It has often happened that boats loaded with fresh quicklime, have, from leakage, slaked with great heat, and such increase in volume as to burst and tear apart the vessel. It has been observed, too, in such cases, that the woodwork has been blackened almost to charring, but yet wanting the appearance of wood that had been on fire. I am not prepared to say that quicklime, in a vessel slaked with less water than is required, would not set fire to wood. I conversed this morning with an old lime boatman, who is a reliable man, and who declares that in one case, of which he was an eyewitness, a boat loaded with lime directly from the kiln, near this city, in passing down through one of the canal locks, met with an accident by which the water from the upper level, escaping through the miter of the gates, was poured down upon the lime, and that in slaking it *burst into a blaze and set fire to a portion of the woodwork.* I inquired whether the lime, which had been loaded directly from the kiln, was not hot when loaded, but he declared it was not, and that lime never was loaded in that condition.

In the case of the boat at Manayunk, it was "burned," which means that the lime slaked became very hot, increased its volume, and destroyed the boat, blackening the timbers as before described, but no actual fire, as far as I have been informed.

Yours very truly, JAS. F. SMITH.

The case of the boat at Manayunk, referred to in the letter, was named by Mr. Trautwine in his letter of inquiry to Mr. Smith, and has no relation to the preceding case given on the authority of the "old lime boatman."

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of THE MANUFACTURER AND BUILDER. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2676) EXPLANATION OF ECHO.—Will you please give in one of your early issues a scientific explanation of the cause of echo, and oblige.—F. D., Louisville, Ky.

(2677) ECONOMY OF HEATING FEED-WATER.—Is there any way of getting at the economy of heating feed-water? I have known some steam users who doubted whether there was any advantage in it.—W. M. B., Harrisburg, Pa.

(2678) THE NEW ANÆSTHETIC.—I read with interest your article on bromide of ethyl, but have since read that the great expectations formed concerning it were likely to be disappointed, because it has proved to be dangerous in use. Should you care to reopen the subject, I would be pleased, as a pharmacist, to have your comments.—W. C. O., Cleveland, Ohio.

(2679) COEFFICIENT OF EXPANSION.—What is meant by the term "coefficient of expansion"?—T. C. J., New Harmony, Ind.

(2680) ADVICE TO A STUDENT.—I have taken up the special course of civil engineering at one of our leading universities, but find, I fear when too late, that I have no taste or talent for mathematics. I do not want to change my chosen profession, but am afraid I shall never be able to make much headway in my studies, or much of a mark hereafter, for the reason I have given. In this quandary I write to you for advice, as I have seen that your answers to other correspondents have been very practical and sensible. Please answer in your next, if you can spare the space, and oblige.—B. J. E., Philadelphia, Pa.

(2681) SPEED OF CIRCULAR SAWS.—What is the rule or practice for the speed of circular saws of different sizes?—J. D. C., Martinsville, Mich.

(2682) SLIDE-VALVE PROBLEM.—(1.) I have a slide-valve which I desire to balance by means of a piston placed on its back. How shall I proportion this piston, as compared to the area of the valve? (2.) By what theoretical considerations can I calculate the frictional resistance of an unbalanced slide-valve, so as to be able to give the valve-rod its proper dimension.—R. T., Philadelphia, Pa.

(2683) INDESTRUCTIBLE INK.—Can you tell me if there is such a thing as an absolutely indestructible ink? and if there is, will you give the recipe for making it. It has often occurred to me, that for public documents of importance, as well as for official documents between private parties and corporations, such as charters, contracts, deeds, and the like, something of this kind would be very useful.—M. B. L., Washington, D. C.

(2684) CRUSHING STRENGTH OF BRICKS.—What is the most that bricks will stand without crushing or splitting?—R. W., Wilmington, Del.

(2685) ATTACHING LEATHER TO METAL.—I will thank you for a recipe by which I can attach leather permanently to metal.—A. C. R., Montpelier, Vt.

(2686) THERMOMETRIC SCALES.—1. What is the principle on which the several thermometer scales have been fixed? 2. What is the method of converting one scale into the other?—S. A., Steubenville, Ohio.

(2687) BENZOIN TINCTURES.—Which is the better for toothache, simple or compound tincture of benzoin? How is each made?—H. L. C., Worcester, Mass.

(2688) GOVERNOR PULLEYS.—Will you please give a rule for fixing the size of pulleys for governors, and much oblige.—H. V. B., Schenectady, N. Y.

REPLIES.

(2630) PROBLEM OF A MARCHING COLUMN.—We have received communications from J. V. B., of Yankton, Dak.; E. H. M., of Cambridgeport, Mass., and several anonymous correspondents, respecting the solution given in our June number to the problem of a marching column. These correspondents have all noticed an error that inadvertently found its way into the clearing of one of the equations. The error was most probably due to the fact that A. R., of Carlisle, Pa., who first requested the solution of the problem, was injudicious enough to state what some one had pronounced to be the correct answer—a fact which is sometimes as misleading to professor as to pupil. The error in question is in stating the value of x in equation $2x^2 - 80x = -375$, to be 5. The true value of x, to satisfy the conditions of this equation, is 5.423. This somewhat affects the final answer, for by substituting the true value of x, as we have done in our former solution, the distance the officer travels is found to be 54.154 miles, instead of 60 miles. The detailed solution is given herewith:

$2x^2 - 80x = -375$; dividing by 2, we have

$x^2 - 40x = -187.5$, and

$x - 20 = \pm\sqrt{400 - 187.5} = 14.577$, and

$x = 20 \pm 14.577 = 5.423$.

Applying this value of x to the equation

$$r = \frac{25 - x}{x}, \text{ we obtain } r = 3.61$$

The entire distance the officer traveled is

$$rx + 15r - rx = 15r = 54.15 \text{ miles.}$$

Our correspondent, J. V. B., obtains the equation $2x^2 - 80x = -375$, in a different manner from that given in our solution. He assumes that the motion of the officer and the column were uniform, and had a direct ratio to each other. Then putting x = the distance the column moved while the officer was riding down the column, he gets the proportion

$$x : 25 - x :: 15 - x : 25 - x + 15$$

Equating this, he obtains

$$25x - x^2 + 15x = 375 - 40x + x^2$$

$$\text{or } 2x^2 - 80x = -375$$

That is, as the distance the column moved is to the distance the officer traveled in going down the column, so is the distance the column moved to the officer's distance when he returned.

(2676) EXPLANATION OF ECHO.—The sensation made upon the brain by sound-waves received through the ear, endures for a definite, though brief period. Therefore, if two sounds follow each other too rapidly, the brain will be unable to distinguish them as separate sounds, and the effect produced will be that of one continuous sound. It is generally accepted that one sound cannot be distinguished from another unless there is an interval of about one-fifth of a second between the arrival of the two succeeding sounds. To be heard distinctly, therefore, sounds should not succeed each other more rapidly than one to every one-fifth of a second. Now, when the waves of air on which sound is being borne, meet, in the course of their expansion, a solid surface, they will be thrown off from it, just as a rubber ball will rebound, and they will return in the direction from which they originally came, and their return will be made with the same velocity. If, for example, we place ourselves before a reflecting surface of this kind—say a high wall—which must be sufficiently large to reflect well, and sufficiently distant, and speak in a loud voice, we may hear two separate sets of sounds. 1st. Those produced on the ear by the direct sound; and, 2d, those produced by the sound waves that have impigned upon the distant obstacle, and have been reflected back to us again. These latter sounds, produced by the reflected sound waves, are echoes. In order, now, that the repeated sound, or echo, shall be distinct, it is necessary that the reflecting surface shall be sufficiently distant, so that the reflected sound shall not be confounded with the direct sound. We have stated in advance of this, that to be heard distinctly, two sounds should not follow each other at a shorter interval than the one-fifth of a second. Now, as sound travels about 1,120 feet in one second, it would travel 1,120÷5, or about 224 feet in one-fifth of a second. Therefore, to have a perfect echo, the reflecting surface must be at least 224÷2, or 112 feet (as the sound will travel 224 feet in going and returning) from the sounding body or speaker. If the distance is less than this, the direct and the reflected sounds blend with each other, and the result will be either that the original sound will be confused or strengthened. If a sound is uttered at the distance of 112 feet from a good reflecting surface, the reflected sound, or echo, will be heard distinctly. If the speaker at this distance utters a sentence quickly, the last syllable only will be distinctly echoed, as the others will be confused with the direct sounds. If the sentence, however, is uttered less rapidly than five syllables to the second, the reflected sounds would have time to go and return so as to be heard before the next syllable would be pronounced, and thus both direct and reflected sounds, or echo, would be heard. At two, three or four times the distance, the last two, three or four syllables respectively of a sentence uttered at a rate not exceeding five syllables per second, will be distinctly echoed, the echoes of the preceding syllables being confounded with the direct sounds. Where there are several reflecting surfaces, as opposite walls, at proper distance, we have the phenomenon of repeated or multiplied echoes, the same sound being successively reflected back and forth. Some very remarkable instances of such multiple echoes are on record. As above stated, where the reflecting surface is less distant than 112 feet, the direct and the reflected sounds become blended or confused. If the direct and reflected sounds reach the ear at nearly the same time, the original sound is then prolonged and strengthened. Thus, in a properly proportioned room, the voice of a speaker is strengthened by the sound waves reflected from the walls and ceiling reaching the ear at nearly the same time as the direct sound. This effect is called resonance. But where the room is very large, the reflected sound is apt to cause confusion of sounds by reason of partial echoes.

(2677) ECONOMY OF HEATING FEED-WATER.—There is a positive economy in heating feed-water, and the gain may be calculated after the following method: To heat one pound of water from zero to the boiling point, and convert it into steam of a given pressure, requires that a certain definite amount of heat shall be imparted to it. A "unit of heat" is the amount of heat necessary to raise one pound of water one degree in temperature.

When at 15 lbs. above atmosphere, 1,191 heat units are necessary.

"	30	"	"	1,198	" "
"	45	"	"	1,203	" "
"	60	"	"	1,208	" "
"	75	"	"	1,212	" "
"	90	"	"	1,214	" "

Assuming 1,200 as an average, and taking the natural temperature of water at 50° Fah., it appears that we must impart 1200 − 50 = 1150 units of heat to every pound of water to convert it into steam. For every 100° that the feed-water is heated, therefore, we effect a saving of

$$1150 : 100 :: 100 : x$$

$$x = \frac{100 \times 100}{1150} = 8.7 \text{ per cent.}$$

If the feed-water could be heated to the boiling point, the greatest economy is obtained. If we take the boiling point at 212°, the gain would be

$$\frac{(212 - 50) \times 100}{1150} = 14 \text{ per cent.}$$

In condensing-engines, the feed-water is taken from the hot-well, which is generally kept at a temperature of about 120° to 130°. A higher temperature in this case would impair the vacuum, and thus neutralize what would be gained by a higher temperature of the feed. For non-condensing engines, the simplest way to heat the feed is by the exhaust from the cylinder, either by passing it into the feed-water tank or by forcing the feed-water through a coil of pipes surrounded by the exhaust steam. Sometimes the opposite plan is adopted, of forcing the feed through a cylindrical vessel, and conducting the exhaust through it in small tubes, after the manner of a surface condenser. If these arrangements are provided with sufficient heating surface, the feed may be heated to 180° or 200°; but care must be taken to provide ample and unobstructed passages for the exhaust, so as not to increase the back pressure, for if the latter is only one pound per square inch higher, the loss, especially where the steam is greatly expanded, may almost neutralize the gain made by feed-heating. Thus, in a Corliss engine, working with 60 pounds pressure, and cutting off at one-tenth, the mean pressure is about 14½ pounds per square inch; if the back pressure is raised 1 pound, the mean pressure would be only 13½ pounds, showing a loss of

$$\frac{1 \times 100}{14.5} = 7 \text{ per cent.}$$

Mr. John Haug, a well-known engineer, who has examined this subject very closely, summarizes his conclusions as follows: "The cost of heating the feed is represented by the interest on the first cost of the heater and the cost of its mainte-

nance, and will vary somewhat according to construction, etc. On an average, the *net gain* by heating the feed, may be assumed as about *five per cent for condensing*, and *ten per cent for non-condensing engines.*"

(2678) The New Anæsthetic.—As is the case with many new and highly promising remedies, it is quite possible that the merits of the new anæsthetic—the bromide of ethyl—may have been overestimated. In the article in our July issue, we simply presented the claims that had been made for it by the distinguished gentlemen who first brought it to notice of the medical profession. We know of no good reason why the favorable opinion they express of it should be altered. The only unfavorable comment that has been made concerning it, so far as we know, was made on the strength of a recent case, in which a patient died in the surgeon's hands while undergoing a surgical operation, which was not usually or necessarily fatal, and who was under the influence of this anæsthetic at the time. The inference that death was caused or hastened by the anæsthetic employed in this case, we think to be hasty and unwarranted, although this statement has made its appearance in the daily papers, as though it were positively ascertained and admitted; and the conclusion has also been drawn from this single doubtful case, that the new anæsthetic is too dangerous and uncertain to take the place of the well-known agents now in use. It would be folly to condemn so promising an aid to surgery and to suffering humanity, on such slim and uncertain evidence as this. It is, however, right and proper that the new agent should be thoroughly tested under every variety of circumstance before its virtues are too highly extolled; and this is what is now being done. As the case now stands, we think it has been demonstrated that the bromide of ethyl is a valuable anæsthetic agent, and the bulk of the experience that has been obtained with it, goes to support the view that we have in it—an agent that is superior to either ether or chloroform. The bromide, however, has not been long enough in use to finally establish this last assertion.

(2679) Coefficient of Expansion.—The coefficient of expansion is the small fraction of its volume by which a solid, liquid or gas is increased when heated from 32° to 33° Fah. (or from 0° to 1° C.) This is very small for solids, greater for liquids, and greatest for gases, which last, having very little cohesion, expand for equal increments of heat much more than solids or liquids. We have given above the definition of the coefficient of *cubical* expansion, supposing this to be what our inquirer means. But we distinguish also linear and superficial expansion with solids, and have therefore a coefficient of linear expansion and a coefficient of superficial expansion, which may be defined as follows: The coefficient of linear expansion is the trifling elongation of a rod of any solid, 1 foot (or 1 meter) long, when heated from 32° to 33° Fah. (or from 0° to 1° C.) The coefficient of superficial expansion relates to the surface under the same conditions. Though not absolutely true, we may say practically that the linear and cubical expansion in any homogeneous solid is so related, that, with the same elevation of temperature, its length, breadth and depth will be increased in the same proportion—that is to say, if a solid, heated to a certain temperature, increases in length say one-1000th of its original length, its surface increases two-1000ths of its original area, and its volume three-1000ths of its original cubical dimensions.

(2680) Advice to a Student.—Let B. J. E. take heart. His case is by no means so desperate as he imagines, and we should advise him, if he has deliberately taken up the study of civil engineering from choice, to stick to it, with the assurance that his lack of mathematical ability, while it may increase his difficulties in mastering many abstruse subjects connected with his studies, is by no means without its offsetting advantages. One of the fathers of his profession, the veteran Trautwine, meets our inquirer's case very fairly in his "Pocket-Book," in the preface to which he says: "Comparatively few engineers are good mathematicians; and in the writer's opinion, *it is fortunate that such is the case*, for nature rarely combines high mathematical talent with that practical tact and observation of outward things so essential to a successful engineer. There have been, it is true, brilliant exceptions, but they are very rare. But few even of those who have been tolerable mathematicians when young, can, as they advance in years and become engaged in business, spare the time necessary for retaining such accomplishments. Nearly all the scientific principles which constitute the foundation of civil engineering, are susceptible of complete and satisfactory explanation to any person who *really* possesses only so much elementary knowledge of arithmetic and natural philosophy as is supposed to be taught to boys of twelve or fourteen in our public shools. The little that is beyond this might safely be trusted to the savants. Let them work out the results and give them to the engineer in *intelligible language*. We can afford to take their word for it, because such things are their specialty, and because we know that they are the best qualified to investigate them," etc. After explaining how easy it would be to teach boys the principles of the lever, virtual velocities, momentum, etc., by turning their see-saws, swings, balls and marbles into philosphical apparatus, and letting them acquire this knowledge at play, he continues: "It is the ignorance of these principles, so easily taught even to children, that constitutes what is popularly called 'the practical engineer,' which, in the great majority of cases, means simply an ignoramus who blunders along without knowing any other reason for what he does than that he has seen it done so before. And it is this same ignorance that causes employers to prefer this practical man to one who is conversant with principles. They themselves were spanked, kept in, etc., when boys, because they could not master leverage, equality of moments and virtual velocities, enveloped in X's, p's, Greek letters, square-roots, cube-roots, etc., and they naturally set down any man as a fool who could. They turn up their noses at science, not dreaming that the word means simply *knowing why*; and it must be confessed that they are not altogether without reason, for the savants appear to prepare their books with the express object of preventing purchasers (they have but few *readers*) from learning why." Our inquirer may take fresh courage from these sensible views and words of one of the masters of his profession. Let him only thoroughly master the principles underlying his studies, and he will have nothing to fear in his future professional career.

(2681) Speed of Circular Saws.—In this case practice has fixed the rules that are generally observed. The ordinary speed of circular saws is from 9,000 to 10,000 feet per minute, which is about 200 times as fast as a push-cut hand-saw, which makes about 100 feet per minute, and cuts only half the time. Grimshaw, in his treatise on saws, gives the following rules of practice: For saws of 12 inches diameter, we may say 3,000 revolutions per minute; 2 feet diameter, 1,500 revolutions; 3 feet 1,000 revolutions; 4 feet, 750 revolutions; 5 feet, 600 revolutions. Shingle, and some other saws, either riveted to a cast-iron collar, or very thick at the center and thin at the rim, may be run with safety at greater speed. He gives the following

TABLE OF SPEEDS FOR CIRCULAR SAWS.

Size of Saw.	*Rev. per Min.*	*Size of Saw.*	*Rev. per Min.*
8 inches	4,500	42 inches	870
10 "	3,600	44 "	840
12 "	3,000	46 "	800
14 "	2,585	48 "	750
16 "	2,222	50 "	725
18 "	2,000	52 "	700
20 "	1,800	54 "	675
22 "	1,636	56 "	650
24 "	1,500	58 "	625
26 "	1,384	60 "	600
28 "	1,285	62 "	575
30 "	1,200	64 "	550
32 "	1,125	66 "	545
34 "	1,058	68 "	529
36 "	1,000	70 "	514
38 "	950	72 "	500
40 "	900		

Richards, in his "Operators Hand-Book," gives the following speeds for circular saws:

Diameter.	*Rev. per Min.*	*Peripheral Velocity. Feet per Min.*
36 inches	1,500	14,100
30 "	1,800	14,100
25 "	2,100	13,700
20 "	2,400	12,500
15 "	2,700	10,600
10 "	3,000	7,000

(2682) Slide-Valve Problem.—(1.) Make the area for the piston for relieving the valve of pressure, equal to the area of the exhaust port, plus the area of one steam port, for a non-condensing engine; but if for a condensing engine, then add the proportional of the steam pressure and the atmosphere. That is, if there be 45 pounds of steam in the chest, it will require one-third the area of the exhaust port to counteract the atmosphere. (2.) The size of valve stems follow practical rather than theoretical considerations, because the frictional resistances vary so much. For instance, 1⅝-diameter valve stems of locomotive slides are frequently pulled in two by the "stick" of the valve; but for all ordinary purposes, such a stem is ample.

(2683) Indestructible Ink.—The idea of our correspondent is good, though not by any means new. In replying to him, we will begin by stating that such a thing as an absolutely indestructible ink cannot be made. But for all practical purposes, an ink that will last—retaining its color—as long as the paper or parchment on which it has been used, is permanent enough, for when these begin to disintegrate, the ink, be it ever so permanent, cannot save the document. The simplest, and we believe, the best permanent ink for such purposes that has been suggested, is made as follows: Make a solution of shellac in borax, to which add sufficient lampblack to give the requisite depth of color. This ink cannot be erased from paper or parchment by any known chemical solvent; it will retain its original color indefinitely, and last as long as the material on which it is written.

(2684) Crushing Strength of Bricks.—The resistance of bricks to a crushing force varies greatly according to the quality of the brick. Trautwine, who has experimented considerably with building materials, says on this point that a rather soft brick will crush under a weight of from 450 to 600 pounds per square inch, or about 30 to 40 tons per square foot, while a first-rate machine-pressed brick will require from 300 to 400 tons per square foot. This last is about the crushing limit of the best sandstone—two-thirds as much as the best marbles or limestones, and one-half as much as the best granites or roofing slates. But masses of brick-work, he notes, will crush under much smaller loads than single bricks. In some English experiments, referred to by this author, small cubical masses only 9 inches on each edge, laid in cement, crushed under 27 to 40 tons per square foot. Others, with piers 9 inches square, and 2 feet 3 inches high, in cement, only two days after being built, required 44 to 62 tons per square foot to crush them. Another, of pressed brick, in best Portland cement, is said to have withstood 202 tons per square foot, and with common lime mortar only one-fourth as much. The same authority, however, is careful to add the statement that cracking and splitting usually commence under about one-half the crushing loads. To be safe, he recommends that the load should not exceed one-eighth or one-tenth of the crushing load; and so also with stone. Moreover, he notes, these experiments were made with low masses, but the strength decreases as the proportion of the hight to thickness increases. He cites the following examples: The pressure at the base of a brick shot tower in Baltimore, 246 feet high, is estimated at 6½ tons per square foot; and in a brick chimney at Glasgow, Scotland, 468 feet high, at 9 tons. Prof. Rankine calculates that in heavy gales this pressure is increased to 15 tons on the leeward side. The walls of both are, of course, much thicker at the bottom than at the top. With walls 160 feet high of uniform thickness, the pressure at the base would be 5.4 tons per square foot. He prudently concludes that with our present imperfect knowledge on this subject, it cannot be considered safe to expose even first-class pressed brickwork, in cement, to more than 12 or 15 tons per square foot; and good hand-molded bricks to more than two-thirds as much.

(2685) Attaching Leather to Metal.—The following method of procedure, it is said, will attach leather to metal so tenaciously that it will split before it can be torn off: Gently heat a quantity of nutgalls in about 8 parts (by weight) of water for six hours, and filter the liquor through a cloth; then dissolve 1 part (by weight) of glue in the same quantity of warm water, allowing it to remain until completely dissolved, replacing the evaporated water with fresh water from time to time. Then apply the glue to the surface of the metal—previously roughened and heated—and thoroughly dampen the face of the leather with the nutgall decoction. Lay the leather on the surface to which it is desired to attach it, and let the cement dry under pressure.

(2686) Thermometric Scales.—1. The principle attempted to be followed in fixing the scales of the different thermometers, has been to start out with some fixed constant, and to divide the scale into a certain number of divisions between this constant and some other. Reaumur and Celsius, whose thermometers are largely used on the Continent of Europe, selected for their two constants, the freezing point and the boiling point of pure water. They started their scales from the freezing point, calling this zero (0°), and divided the space between this and the position occupied by the liquid (mercury or alcohol) when water boils, respectively into 80 and 100 equal parts or degrees. Fahrenheit noticed that a mixture of salt and ice produced a greater degree of cold than that of freezing water, and fixed on the temperature of this mixture as his zero or starting point, dividing his scale between zero and the boiling point of water into 212 equal parts or degrees. The freezing point of water on this scale occurs at 32° above zero, and between the freezing and boiling points there are 180 divisions or degrees. The number of divisions, and their size and value, are obviously arbitrary. 2. From what has been said above, it will be manifest that 180° Fahrenheit=100°Celsius=80° Reaumur; therefore,

$$1° \text{ Fahrenheit} = \frac{5°}{9} \text{ Celsius} = \frac{4°}{9} \text{ Reaumur.}$$

But as with Fahrenheit's scale, the freezing point is fixed at 32° and not at 0°, as with the other two, it is evident that we must subtract 32 when we convert + degrees of Fahrenheit into those of the other scales, and add 32 when we convert degrees of the other scales into Fahrenheit. We give a few examples, to show the application of our rule: To convert 50° Celsius (or Centigrade) into Fahrenheit degrees,

$$50 \times \frac{9}{5} = 90 + 32 = 122° \text{ Fahrenheit.}$$

To convert 50° Reaumur into Fahrenheit degrees

$$50 \times \frac{9}{4} = 112.5 + 32 = 144.5° \text{ Fahrenheit.}$$

To convert 50° Fahrenheit into Centigrade and Reaumur,

$$50 - 32 = 18 \times \frac{5}{9} = 10° \text{ Centigrade;} \quad 50 - 32 = 18 \times \frac{4}{9} = 8° \text{ Reaumur.}$$

(2687) Benzoin Tinctures.—So far as we have any knowledge of the question, there is no choice between the two substances named by our correspondent. If there is any, it would be in favor of the simple tincture. The mode of preparing the two tinctures is as follows: *Tinctura Benzoini* (simple tincture).—Take of benzoin, in moderately coarse powder, 6 Troy ounces; alcohol, 3 pints. Mascerate for seven days, and filter through paper. *Tinctura Benzoini Composita* (compound tincture).—Take of benzoin, in coarse powder, 3 Troy ounces; socotrine aloes, in coarse powder, ½ Troy ounce; storax, 2 Troy ounces; balsam of Tolu, 1 Troy ounce; alcohol, 2 pints. Mascerate for seven days, and filter through paper.

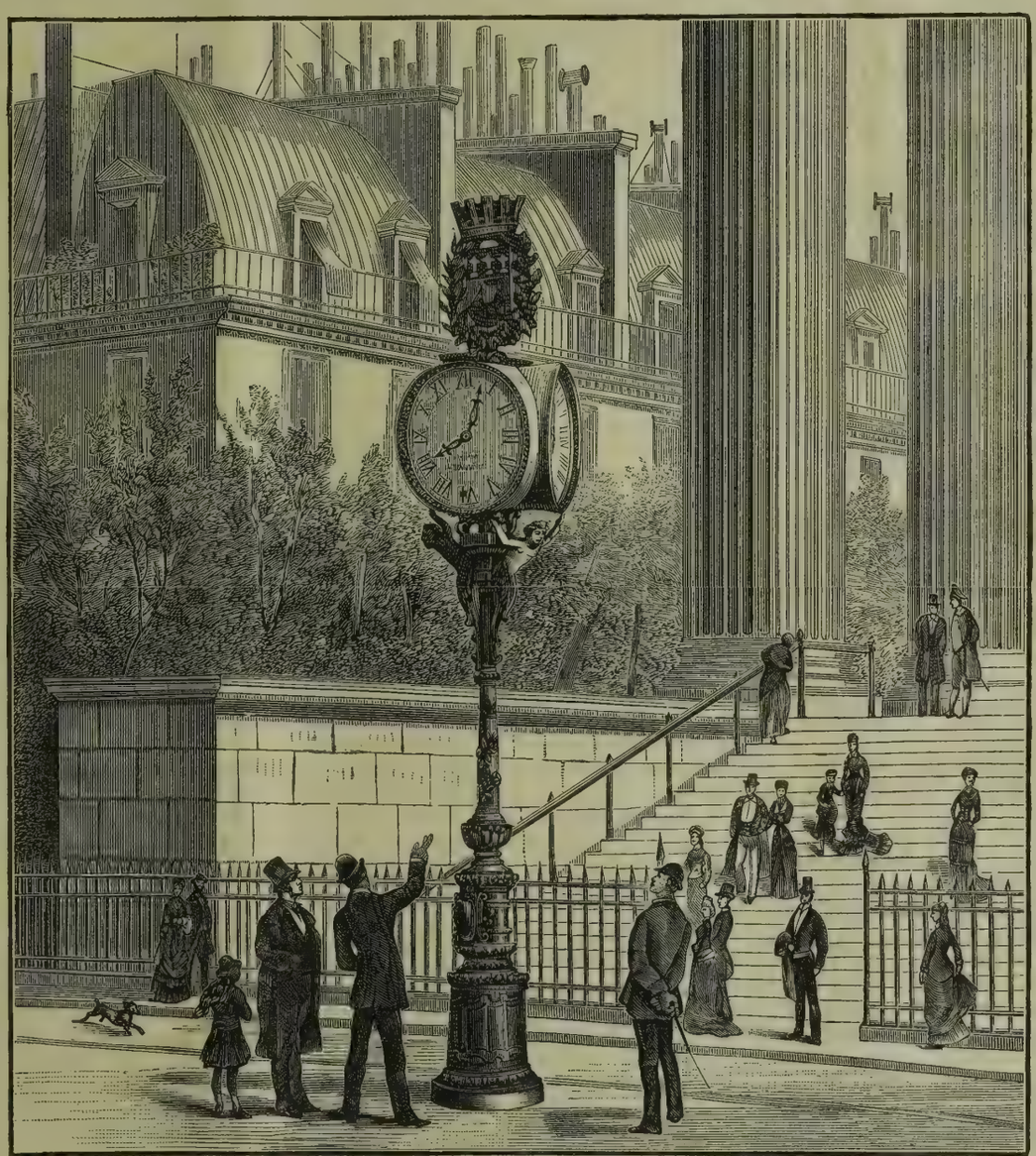
(2688) Governor Pulleys.—*To find the diameter of the governor shaft pulley*, multiply the number of revolutions of the engine by the diameter of the engine shaft pulley, and divide the product by the number of revolutions of the governor. *To find the diameter of the engine shaft pulley*, multiply the number of revolutions of the governor by the diameter of the governor shaft pulley, and divide the product by the number of revolutions of the engine.

THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 10 OCTOBER, 1880. TWELFTH YEAR.

Pneumatic Clocks.

The accompanying illustration gives a representation of a street clock operated on the pneumatic principle, a convenient system which has been largely adopted in Paris and other cities of continental Europe. Compressed air in this plan is made use of to operate all the clocks of a city or district simultaneously, precisely as electricity is similarly employed. The parts of the pneumatic clock system are, the central clock, the receiving clocks, and the tubes and intermediate mechanism for conveying compressed air to the receiving clocks. At the central station a reservoir of compressed air is provided, containing about 25 cubic feet at about five atmospheres pressure. From this reservoir the compressed air is conducted to a second reservoir, in which its pressure is regulated at seven-tenths ($^7/_{10}$) of an atmosphere. Every minute the distributing reservoir is placed in communication with the distributing tubes by the action of the mechanism of the central or distributing clock. The central station is provided with several of these clocks, so that if one should become disordered another can be set in operation within a few seconds. A distributing tube connects with the several mains which convey the compressed air into the various districts where pneumatic clocks are provided. The mains are of wrought iron, $1^1/_{16}$ inches in diameter, and are connected with lead tubes three-5ths of an inch in diameter, for conveying the air into the houses where necessary. With a pressure of seven-10ths of an atmosphere, it is found that any required number of clocks can be operated at a distance of from one to two miles from the central station.



PNEUMATIC CLOCK IN PARIS.

The action of the receiving clocks is about as follows: A small bellows, resembling that used in pneumatic call-bells, is in communication with the tubes conducting the compressed air from the central office. Every minute the pressure of the air raises the bellows, and a rod attached to the upper bellows-head actuates a lever which engages with a wheel provided with 60 teeth, which is rigidly secured to the minute-hand arbor. The wheel rotates the distance of one tooth every minute, and a weighted pawl on the other side of the dial checks this movement. The hour-hand is rotated by means of the usual dial wheels. By means of a second bellows the clock may be arranged to strike. The ordinary spring and weight clocks can be easily transformed into pneumatic receiving clocks.

The mechanism of the receiving clock is alike in all cases, and is entirely independent of the size of the dial or the location of the clock. It is asserted that many of the principal hotels, railway depots, public buildings, courts and the like in Paris, are provided with clocks operated on the principle above described. One of the most useful applications of the system is that shown in connection with a street clock. A number of these pillar clocks, of very ornamental appearance, and illuminated at night, are said to have been erected in that city.

We are informed that it is the intention of a company that has lately been organized, to introduce pneumatic clocks into American cities.

Early Iron Making in England.

In the reign of Edward III. iron was so scarce that the pots, spits and frying pans of the royal kitchen were classed among the king's jewels. Up to the end of the fifteenth century, English iron was not only dearer but inferior to that manufactured on the continent. During the fifteenth century the manufacture of iron began to be extensive in Sussex, where the ore and timber for smelting it abounded, and iron mills soon became numerous in the country. The landed proprietors entered into the business eagerly, and not only were many ancient houses enriched therby, but several new men acquired wealth and founded families. In the forest of Dean also iron was largely smelted, but the land soon became denuded of trees in consequence of the exclusive use of charcoal for smelting; people became alarmed, and many edicts were fulminated restricting the manufacture of iron. Eventually the feeling became so strong, that from the time of the Restoration the iron manufacture of England rapidly declined. Coal as then used, injuriously affected the quality of the iron, and it was not till the beginning of the 18th century that steps were taken to overcome this difficulty.

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Vol. XII. No. 10. TWELFTH YEAR.

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The Commercial Aspects of the Canal Across the American Isthmus.

MR. NIMMO'S CONCLUSIONS AND SOME REMARKS THEREON.

Mr. Nimmo, the able Chief of the Bureau of Statistics, has published in his latest quarterly report a very full and interesting report on the commercial aspects of the proposed canal across the American Isthmus. Mr. Nimmo's paper is interesting in a double sense; first, because it embodies the views of the official head of the statistical bureau, and second, because, unlike all previous writers on this subject, he announces conclusions which are distinctly unfavorable to the commercial success of this projected enterprise. We present herewith the conclusions reached by him, which he has summarized under thirteen heads, as follows. He holds:

1. That the shipping which would annually pass through the proposed American Inter-oceanic Canal, would be about 1,500 vessels, or 1,625,000 tons annually.

2. That upon the basis of shortest voyages, the possible amount of tonnage which, during the latest year for which the statistics can be collected, might have passed through the Suez canal, was about twice as great as that which might have passed through the proposed American canal, and that upon the same basis the possibilities of the Suez canal, with respect to value of commerce, were 3½ times as great as those of the proposed American canal.

3. That the traffic of the proposed American canal would probably be confined, as is the traffic of the Suez canal, almost exclusively to steam vessels; that sailing vessels would continue to take the passage via Cape Horn when engaging in trade west of that point; and that sailing vessels would continue to take the passage via the Cape of Good Hope when engaging in trade east of that point.

4. That during the latest year for which commercial statistics can be collected, the proposed American canal might have afforded a passage for $7^{8}/_{10}$ per cent of the foreign commerce of the United States, 2¾ per cent of the foreign commerce of Great Britain, 1½ per cent of the foreign commerce of France, and less than 3 per cent of the international commerce of the globe upon the ocean.

5. That there has been a very large diversion of traffic from the route between San Francisco and New York via the Isthmus of Panama to the trans-continental railroad already constructed in the United States, the value of commodities transported between New York and San Francisco via Panama having fallen from $70,202,029 in 1869 to $4,947,755 in 1879, and the number of passengers having fallen from 26,853 in 1869 to 4,496 in 1879.

6. That the trade between the Atlantic and Pacific ports of the United States via Cape Horn, has also been, to a considerable extent, diverted to the trans-continental railway line.

7. That there is now a large and growing commerce between the Pacific ports of the United States and interior points east of the Rocky Mountains—chiefly St. Louis, Chicago and Cincinnati. The proposed canal would not present any direct competition to this trade between interior points in the United States and ports on the Pacific coast.

8. That in the event of the construction of an American inter-oceanic canal, the commerce between the Pacific ports of the United States and Europe would probably seek the passage through the proposed canal in steam vessels.

9. That the magnitude of the commerce of the countries on the western coast of South America is limited by that most marked orological feature of the continent—the Andean range, extending from the Isthmus of Panama to the Straits of Magellan, and also by conditions of climate and soil.

10. That the shipment of guano and nitrate of soda from the western coast of Peru and Bolivia to Atlantic ports of the United States and to Europe, giving employment to about 810,000 tons of shipping annually, would probably continue to follow the route via Cape Horn.

11. That the part of the trade of Chili with the Atlantic ports of the United States and with Europe via Cape Horn, giving employment to about 385,000 tons of shipping annually, would probably continue to pursue that route.

12. That 28 per cent of the tea imported into the United States during the year ended June 30, 1879, was imported at Pacific ports, and 72 per cent at Atlantic ports of the United States, and that probably the entire tea supply of the Atlantic seaboard States will eventually be brought from the countries of its production to San Francisco, and thence overland by rail.

13. That on account of the nautical conditions involved in the passage through the proposed canal, sailing vessels engaged in trade between the Atlantic seaboard of the United States and Australia and New Zealand, will probably continue to pursue either the passage around Cape Horn or the passage around the Cape of Good Hope.

The most noteworthy conclusion reached by Mr. Nimmo, is his estimate of the traffic that will annually pass through the canal—namely, 1,500 vessels, or 1,625,000 tons, which represents about one-third of the present traffic of the Suez canal. This estimate is so far below those of other experts who have examined this subject, that it will be instructive to look closely at Mr. Nimmo's statements, to determine how so large a discrepancy can be accounted for. The paragraphs following No. 1, give us the necessary data from which to contrast and compare Mr. Nimmo's reasoning with that of other writers on this important theme.

Mr. Nimmo, it will be observed, from his third conclusion estimates that the traffic of the American canal will probably be confined chiefly to steam vessels, as is the case with that of the Suez; and following this are a number of conclusions, of which the more important are these: That the carrying trade under sail, including the enormous guano and nitrate traffic of the west coast of South America, amounting to not less than 800,000 tons, would continue to find its way to Europe and to our own Atlantic ports, by way of Cape Horn; that the trans-continental railroad across the United States, which has already diverted a considerable percentage of traffic from the Isthmus railroad and from the passage of Cape Horn, will continue to attract commerce, whether the Isthmian canal is built or not; and that the immense trade of China and Japan with the Atlantic seaboard seats of this country will eventually be entirely absorbed by the railroads of the United States.

These conclusions are of serious import, and should they be found to be justified by facts, then the Panama canal had better not be built. Let us consider these conclusions; and first, that respecting the probable amount of tonnage the canal would be likely to command, as all the others lead up to this one.

On this point, a comparison of Mr. Nimmo's figures with those of other writers will be instructive. We find, for example, that M. Levasseur presented a report on this same topic at the late Paris Congress, in which he estimated the probable annual traffic of the American canal at 3,500,000 tons. Admiral Davis, of our navy, ten years ago, while the trade of our Pacific ports was yet in its infancy, held that the annual trade that the canal would command would reach 3,300,000 tons; and Mr. E. H. Derby, in his very interesting *resumé* of the commercial aspects of the American canal, which we published in our May number, after summarizing all the sources from which the canal would derive support, feels himself justified in making a handsome allowance for the growth of commerce during the progress of the work, and including this allowance, he holds "that the aggregate must reach between five and six millions of tons—nearly twice the tonnage which passes yearly through the Suez canal;" and he adds, "this estimate is not a large one."

In the same manner, M. Levasseur adds to his figures a liberal allowance for the increase of commerce during the building of the canal, and his figures for the year 1897, "when the canal will probably be opened for traffic," reach the immense total of 7,250,000 tons. Mr. Nimmo, on the other hand, makes no allowance for the increase of commerce for the next decade and a half—an important omission that must seriously affect the reliability of his estimate.

Another serious omission of Mr. Nimmo's must be noticed in the fact, that while he excludes sailing vessels from the canal, he makes no allowance for the rapid and universal substitution of steam for sails in the carrying trade of the world, which has been going on for years, and which may reasonably be expected to continue during the period in which the canal is being constructed, and which, at the end of twelve or fifteen years, when the canal would probably be opened for traffic, would almost certainly have so far progressed that the major proportion of trade now carried in sailing vessels will then be carried in steamers.

Finally, we may add that the conclusion of Mr. Nimmo, that sailing vessels would not patronize the American canal, which is founded on the fact that the traffic of the Suez is chiefly derived from steam vessels, has been criticised on the ground that the cases of the two canals are by no means parallel. The passage of the Suez canal, it is said, necessitates a dangerous voyage

through the Mediterranean, and a still more dangerous one through the Red Sea and the Gulf of Aden; while the Panama route is asserted to be wholly free from danger on the Pacific side, and almost equally so on the Atlantic side, if a southerly course is taken through the Caribbean sea, and the open sea is reached by the Mona passage.

From the above, our readers will be able to judge whether Mr. Nimmo's conclusions are so well founded as to throw serious doubts on the commercial success of the projected canal. As to ourselves, we think that the truth will be found to lie somewhere between Mr. Nimmo's very low estimates and Messrs. Levasseur's and Derby's very high ones.

The Evils of Expertism.

The disrepute which has attached itself to expert testimony in our courts is a matter of general notoriety, and to professional men, a subject of deep regret. Of late it has become so common a sight in our civil and criminal courts to see "expert witnesses" pitted against each other, and to hear of cases pending on the issue of "a war of experts," that it is not surprising to find that a very low estimate is placed upon the moral weight of evidence of this class.

The temptation of large fees to be earned by services of this kind has, unfortunately, called into existence a class of professional experts whose talents, it is well known to litigants and attorneys, are in the market, for sale to the highest bidder. It is well understood that these men, when retained on this or that side of a controversy act simply and purely as the hired advocates of their clients, irrespective of the merits of the case at issue. The discredit that has attached itself to the testimony of experts, as at present presented to our judicial tribunals, has become so notorious that it has completely perverted the original purpose of such evidence—namely, the instruction of court and jury, and has even, by indirection, brought science herself into contempt. These evils have become so great that a reform is imperatively demanded. The sight of several experts, hired by the advocates to a controversy, rising before court and jury and testifying to diametrically opposite things, is anything but an edifying spectacle to men who honor their profession; and yet this sort of thing, so far from being rare, is of almost daily occurrence. The medical profession, from the greater frequency with which such special knowledge is called for, has suffered most from the discreditable public performances of experts. But the evils we complain of are by no means confined to this profession. The subject is of so much importance, that we have been tempted to present our views of it at some length.

In attempting to get at the cause of these evils, we are forced to the conclusion that the whole trouble has arisen from the manner in which experts are employed. It will be evident to any one who takes time to consider the subject, that the leading idea in employing expert testimony, was, originally, that the court and jury might have the advantage of the professional opinion of a witness, who, by reason of special training, was thoroughly skilled, or expert, respecting the subject on which his testimony was required. In this view of the case, which is the only proper one, the expert witness is the *amicus curiæ*—the friend of the court; and his appearance in the role of a partisan is a complete perversion of his status. In this light his position is very different from that of an ordinary witness. It is in a certain sense analagous to that of the judge, for as the latter must interpret with judicial impartiality the questions of law touching the case in hand, so the former should be looked to, to interpret the scientific and technical questions that are involved in it, unbiased by the partisan prejudices of a hired advocate. That this is the true position of the expert witness, seems to us to be self-evident. And it must be equally self-evident, if this be the case, that the first and most important step to be taken in reforming the evils of expertism, is to radically change the method of employing this class of witnesses, by taking their employment out of the hands of the parties to a legal controversy and lodging the duty of their selection with the court or the State. It may be urged, perhaps, that the experts themselves are responsible in a large measure for the discredit which has attached an unsavory odor to expert testimony, and that a change in the mode of selecting them will only partially help the case. With this conclusion we cannot agree.

It is unfortunately true that some of the men who figure constantly in our courts as medical or chemical experts, are much to blame for the disrepute into which expertism has fallen. But we hold that their offenses must be credited in a great measure to the vicious system that makes the expert a hireling. Men of science are neither better nor worse than other men, and under the operation of a system which permits the expert to be retained by litigants, precisely as an attorney, to make the best of a case, good or bad, it is only natural that the temptation of large fees should have called into existence a class of "professional" experts whose services are at the command of the highest bidder, and who, in the absence of that moral support which the recognition of their true position would give, serve their clients through thick and thin, even to the length of making the worse appear the better reason. And what is worse, this view of their duty is not confined to the host of quacks and pretenders who are attracted to the business of expertism by the scent of the spoils, but is shared very generally by reputable and distinguished men of science as well. With rare exceptions, they all act on the common principle of the hired advocate; they set themselves "to work up the case"; to cover up its weak points; to discover the greatest number of flaws in the statements of the opposing expert, and, if needs be, to mystify court and jury with all the devices of perverse ingenuity, aided by words of ponderous sound and learned length.

It is the existing system that has developed this state of things. Abolish the system, and we lay the axe to the root of the evils of expertism. Place the expert in his true position as "friend of the court," and he is invested at once with a moral dignity that he now lacks, and which is the one thing needful to redeem the whole subject of expertism from the discredit into which it has fallen.

As the medical profession has come more severely under the fire of criticism by reason of the scandals of expertism, it is fitting that the movement for the reform of existing evils should emanate from members of that profession. A movement looking to such reform has been started by a number of reputable physicians of our neighbor city Philadelphia, who have decided to appeal to the Legislature of the State of Pennsylvania for aid in effecting it. The remedy which these gentlemen propose to apply, though by no means as thorough as we should like to see it, is nevertheless a good one so far as it goes. It is substantially as follows:

"In cases likely to require the aid of medical experts the counsel on either side shall each select the names of six or more prominent physicians. From this list the presiding judge is to select two, indiscriminately. Those thus chosen shall sit with the judges as *amici curiæ* throughout the whole trial, giving special attention to those points which may require their professional assistance as medical experts, so that they may enlighten the court and jury on the technical aspects of the case. It shall also be their duty, if required, to make any necessary medical and chemical examinations in the progress of the trial. For the above service, it is proposed to pay each *amicus curiæ* a stipulated fee, say $300, for each case requiring chemical analysis, examinations, etc., with which a per diem allowance is also to be incorporated. This arrangement is not intended to prevent either side calling other expert witnesses, only the testimony of the latter must be weighed and tested by the others."

A bill embodying the points contained in the above, we understand, is to be presented and urged for passage at the next session of the Legislature of the State of Pennsylvania. We shall be glad to see it passed, for though in some important respects the proposed reform is inadequate, we see in the proposition a step in the right direction; and the ground once broken by legislation, whateyer deficiencies the new law may manifest when put into operation, may be made up by future amendments.

It has been urged that the proposed legislation is defective in that the reforms it contemplates are confined to the selection of medical experts only; that physicians "indiscriminately chosen" by the court might not be the most competent; that few "distinguished physicians" engaged in active professional work would care to sit throughout a tedious trial, continuing perhaps for weeks, besides making "chemical and other required examinations," for the sum of $300 and a per diem allowance; that few distinguished physicians are at the same time competent to make chemical examinations; and that, finally, if other experts, hired by the litigants, are allowed to testify, the old difficulty of personal collision would constantly recur. These objections are certainly valid, and should be carefully considered and provided against in the preparation of the bill to be presented, as there is still an abundance of time to modify its provisions. We therefore hope that this will be done.

As a type of a law which is in every way adequate to meet the difficulties of the case as we have endeavored to present them, we append an exposition of the Prussian system, from the pen of a distinguished toxicologist, who has taken much interest in the reforms proposed in our neighbor State. With the views that he expresses below, we are satisfied that our readers will fully coincide:

"The only true method of meeting the difficulty, it seems to me, is to adopt an arrangement somewhat similar to the Prussian system, which is admitted by all legal physicians to be the best known, and a modification of which might readily be engrafted on our American practice, somewhat after the following plan: Let there be appointed by the proper authorities for each State, one (or more) thoroughly educated, practical physician, properly trained in all the details of medical jurisprudence, including toxicology, who shall be named the State medical expert. His duties shall be to attend at any criminal trial in his district when summoned by the court, as the skilled witness for the prosecution. He shall act as the *amicus curiæ* before mentioned; he shall be prepared to make all the requisite medical and toxicological investigations in any case requiring them. [Thus in poison cases the District Attorney would be saved the annoyance and expense of hunting up a suitable toxicologist.] By his expert testimony the prosecution would always be guided.

"He should possess a chemical laboratory and all the other appliances necessary to the complete fulfillment of his duties. Although summoned by the State, he is by no means to be considered in the light of a partisan any more than the judge upon the bench. He can have no temptation to a bias for either side. He would give his verdict grounded solely upon truth, and his moral and professional character and acquirements should be such as to preclude the possibility of error, so far as is consistent with human infirmity. In many criminal trials the testimony of such an official expert, commanding, as he ought to do, the respect and confidence of all parties, would be deemed fully adequate to settle all scientific questions, even by the defense. But there doubtless would seem some cases in which the defense would claim the right (and of course it would always be conceded) of employing their own expert. This need not interfere in the least with the State's officer, since, if the testimony of the former conflicted with that of the latter, the accused would still have all the advantage which he would possess under the present system.

"The salary should, of course, be sufficiently ample to command the very best talent, inasmuch as the medical officer would necessarily be compelled to relinquish all practice and devote himself exclusively to his State duties. But even in an economic point of view, the State would probably not be a loser, inasmuch as the aggregate yearly amount which the various counties are compelled to pay for toxicological and other examinations in their respective criminal trials, would equal, if not exceed, even a liberal salary allowed to the State expert. The only real difficulty would probably be in the mode of appointment. Unquestionably such an office ought to be lifted high above all political favoritism. It should be bestowed only upon the most competent. But who shall decide this important question? Certainly not the Legislature, for it could have no means of judging of qualifications, except through the representations of constituents, and everybody knows that these must partake largely of the political element. Neither should the responsibility be laid on the Governor, for a similar reason. The State Medical Society might, by some, be deemed the proper body to at least suggest the suitable appointee to the civil authority; but there would, even here, be some risk of cliquism or favoritism. On the whole, the safest body with whom to lodge the responsibility would be the Judges of the Supreme Court of the State. They might act in full council, after due consideration of the claims of the respective applicants, and their decision, to be determined by vote, would doubtless be deemed impartial and satisfactory by all."

Stead's Attachments for Steam Boilers.

According to announcement in our last issue, we present herewith a description, with suitable illustrations, of the improved circulating and feed-water heating devices for steam generators, invented and patented by Mr. J. C. Stead, 102–106 West street, corner Kent, Greenpoint, Brooklyn, N. Y.

Our attention was first called to certain of Mr. Stead's devices for effecting thorough circulation and increasing the steaming capacity of boilers, in 1877, and our readers will find his earlier form of apparatus described in our December number for that year, under the title of "An Economical Boiler Attachment." The performance of this earlier device was so favorable, and we were so much impressed with its merits, that we gave it our warm approval. Since that time, Mr. Stead has greatly improved and perfected his devices, while still, however, retaining substantially the same principle. The inventor's practical familiarity with steam machinery for some thirty years, especially in the fitting up and repairing of steam boilers, has given him unusually favorable opportunities to perceive their defective points and to remedy the evils arising from them. And we may mention incidentally, that the present successful inventions of Mr. Stead originated from the necessity of running certain large works, in which two boilers had been destroyed by fire. These were replaced by one boiler of same size, to which was attached a circulating and feed-heating device, which proved very successful, and which embodied, though crudely, the ideas which he has since elaborated and perfected.

To understand the nature of the improvements which Mr. Stead has made, it will be proper to briefly state the essential features of the earliest form of his boiler attachment. This consisted of a drum supported on a brick bridge-wall, at a proper hight to leave an effective space between the same and the boiler for heating its contents, and connected with the boiler by means of suitable pipes communicating with the steam and water space. By this arrangement Mr. Stead succeeded in obtaining a very thorough and continuous circulation, the intense heat of the furnace was utilized in producing an increased evaporative effect, and the formation of scale was notably prevented by the collection of sediment in the drum (from which it could be blown out from time to time), that otherwise would have attached itself to the boiler. In the rear of this combined mud-drum and water bridge-wall, Mr. Stead employed a system of heavy lap-welded tubes, extending in a continuous close coil, connected by return bends under the boiler from the bridge-wall to the back connection wall, and forming, in effect, a combustion chamber, in which the combustion of the furnace gases was maintained and the flame held in close contact with the boiler-shell until it struck a deflecting wall, under which it passed and entered the boiler flues. This series of tubes (entirely independent of the drum and its attachments) was connected at one extremity with the feed-pump and water-space of the boiler, and at the other with the steam-space. The object of this attachment was to effect the heating of the feed-water to a high temperature, before admitting it to the boiler, in the most economical manner possible—namely, by utilizing a portion of the heat of the furnace gases which would otherwise be wasted, or but partly made effective. An automatic valve, which opened so soon as the action of the feed-pump ceased, provided that the circulating pipes should always be charged with water. Thus the apparatus provided for the rapid and continuous circulation of water in all parts of the boiler, protected the boiler against the formation of scale, and provided an excellent feed-heater which delivered water into the boiler at a temperature at all times nearly equal to that of the boiler, and in many cases higher.

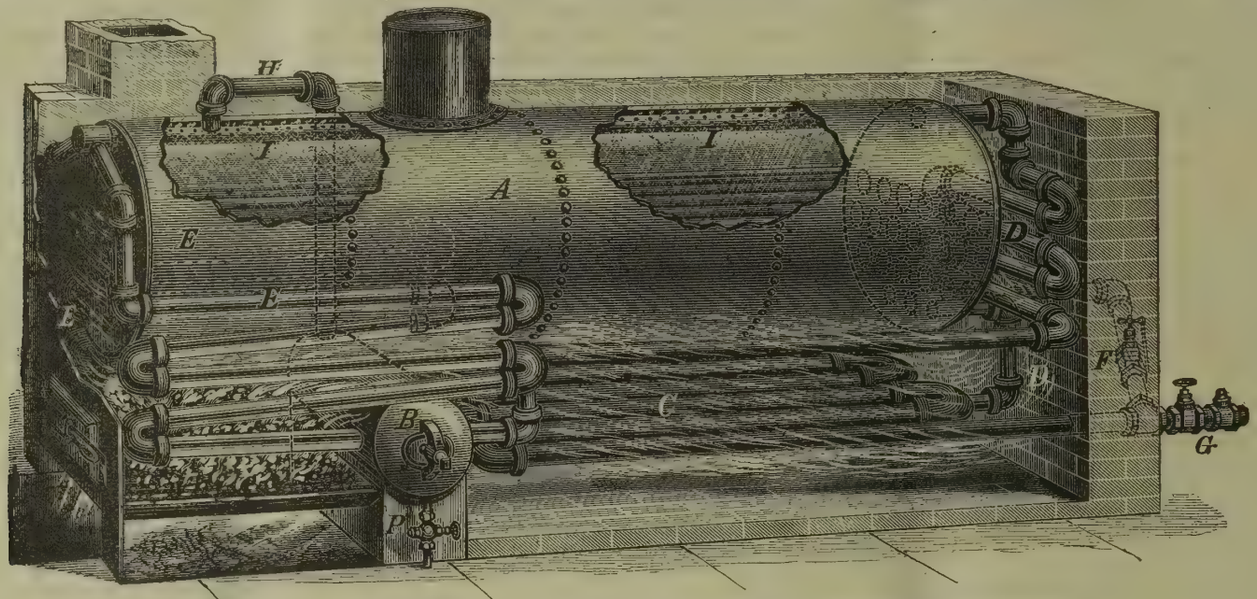


Fig. 1.—Stead's Circulating, Feed-Heating and Fuel-Economizing Attachments to Steam Boilers.

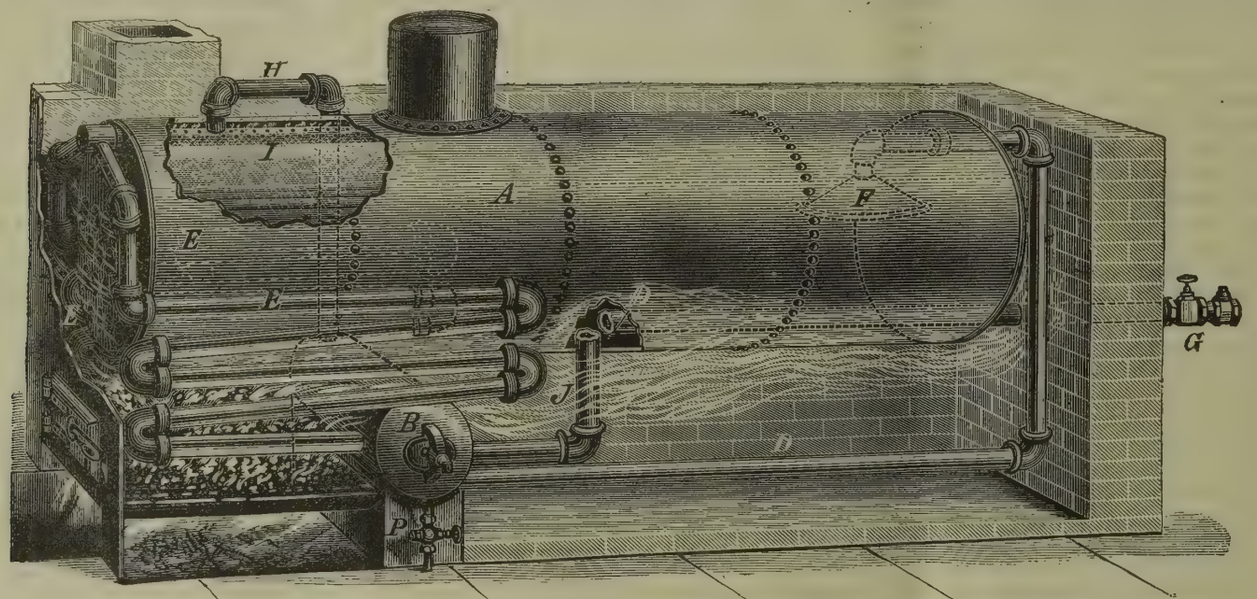


Fig. 2.—Stead's Circulating and Feed-Heating Attachments—Modified Form, without Feeding Coil.

This apparatus proved itself very durable in practice, and remarkably successful in increasing the steaming capacity of boilers to which it was attached, and in effecting a marked saving in fuel. In substantiation of these statements, we shall present the results of careful scientific and practical tests of the device further on.

The improvements made in this apparatus will now be noticed, and will be readily comprehended by a comparison of the foregoing with the following description and reference to the illustrations. Fig. 1 shows a tubular boiler supplied with substantially the same at-

tachments above described, but with several important additions. The reader will observe the water-bridge wall D, with its connections to water and steam space of boiler, and the bottom feeding-coil C, with its boiler connections substantially as above described; but in addition to these, there will be seen a system of coils E at the sides of the boiler, a similar rear-end coil and front-end coil. These attachments form a connected system of circulating pipes for utilizing to the utmost practicable limit the heat of the furnace. The lateral system consists of a series of open return bend pipes, masoned in between the pipes with fire brick. Being constantly filled with water, their presence largely reduces the liability of the bricks to burning out. The whole system of pipes returns into the top of the boiler into the perforated distributing pipe I I. Through this likewise the feed-water enters the boiler after having passed through the coils of the circulator, and from this the water is distributed downwards in a fine spray throughout its length, while the steam escapes through the upper perforations. The bottom feeding coils are inclined somewhat, as shown in Fig. 1, the water being fed through G into the lowest side of the system, and passing as steam and water into the boiler from the elevated side. A check-valve F prevents the water from going directly into the boiler, but as soon as the action of the feed-pump ceases, it opens and allows the water from the boiler to enter the coil, thus preventing its burning out, and maintaining continuous circulation. The drum B, which is also slightly inclined, to facilitate the accumulation of sediment in the blow-out end, acts, as above remarked, in the double capacity of a bridge-wall to fire against and a mud-drum to receive and separate sediment and scale.

Fig. 2 shows a modification of Mr. Stead's device, being substantially the same device, with the rear feeding coils left off. The attachments in this case consist of a water-bridge wall, lateral circulating coils, and circulating arch around the doors. In this arrangement it is designed to feed into the drum in place of the feeding coils of Fig. 1.

Fig. 2 is shown to be provided with a syphoning arrangement F, by which scum and other light substances floating on the water surface can be blown off from time to time. Fig. 3 shows Stead's attachments placed over a puddling furnace in connection with a boiler. There is used in this case the drum and lateral coils. The mud drum is placed over the take-up, to take the place of a brick arch usually introduced to prevent the burning out of the bottom of the boiler, because of the great heat concentrated upon it at this point. The mud drum is set at an inclination, the low end extending through the wall, so as to allow the mud and scale to settle in the lower end of the drum, away from the fire, from which it may be blown off when desired.

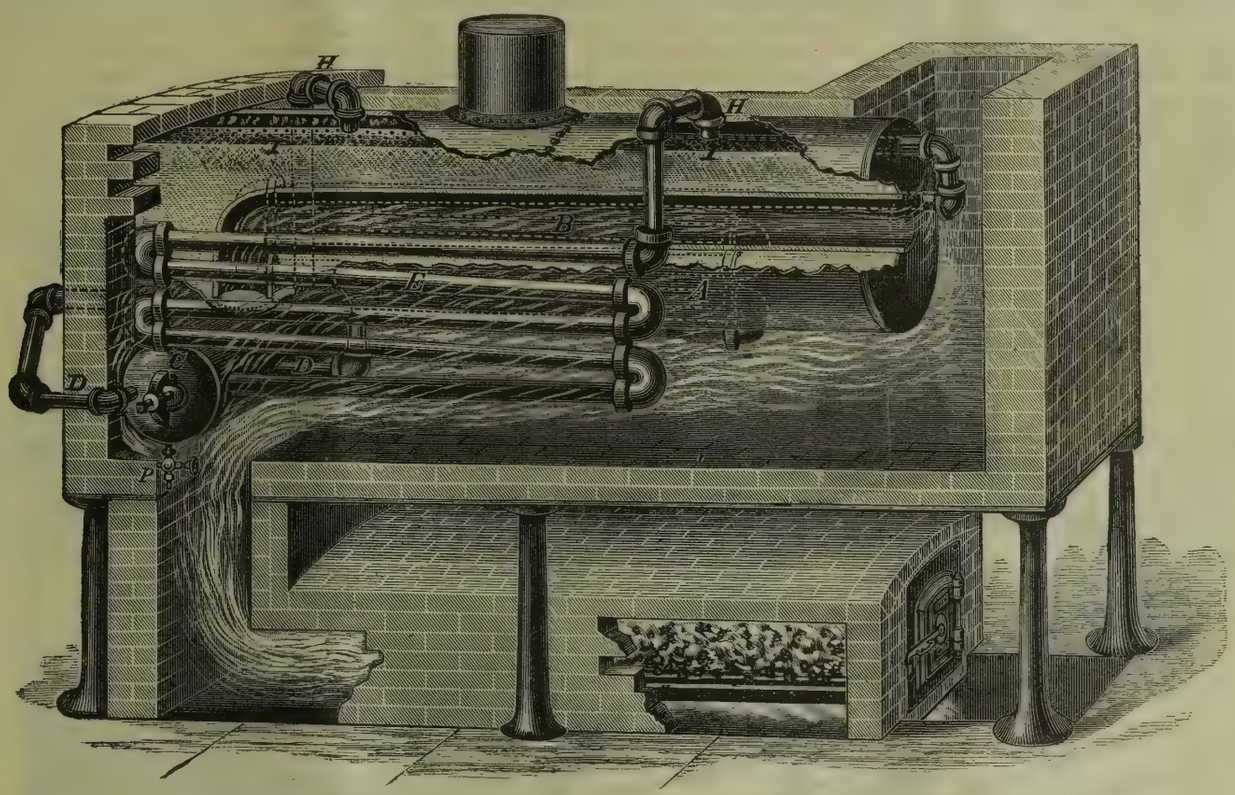


Fig. 3.—Stead's Attachment—Modified Form for Puddling Furnaces, such as Roebling's and the Pencoyd.

Fig. 4 represents a water-arch frame placed around the furnace doors of boilers, and intended to take the place of cast-iron and brick arches, which rapidly give out. Like other portions of this circulating system, it does its share in the economizing of fuel by utilizing the heat which would otherwise be lost, or only partially utilized, and its presence avoids the burning out of the brick or cast-iron arch.

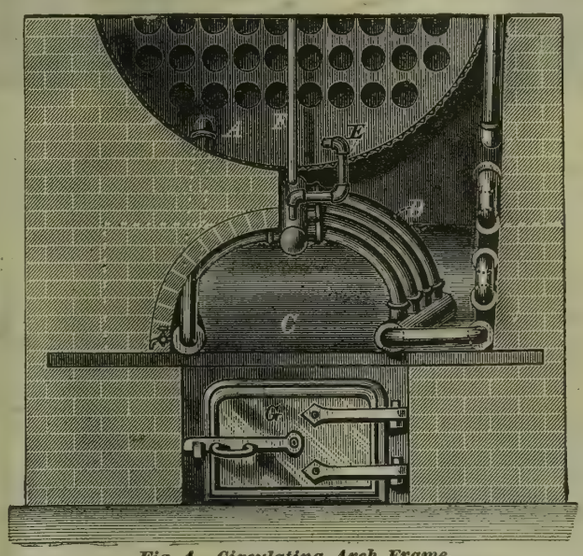


Fig. 4.—Circulating Arch Frame.

Of the decided economy of these devices in increasing the steaming capacity of boiler to which they have been attached, and in notable saving of fuel, the evidence in our possession leaves no room for doubt; and the durability of the attachments seems to have been well substantiated by long and successful service.

From the mass of testimony received on these points, we select some of the more prominent cases, though all the tests are highly satisfactory.

The following test, made by Prof. R. H. Thurston, of the Stevens Institute, was that of a boiler at Faber's Pencil Works, Greenpoint, L. I. The results of this test are highly favorable to the merits of Mr. Stead's invention, since it was made with an earlier form of his attachments, and before his recent improvements had been made. This boiler was one of the first provided with these attachments, and we glean from the testimony of Mr. Eberhard Faber, that the boiler now running the works is rated as a 40 H. P. boiler with Stead's attachments. It has been in use constantly for about five years, with attachments on, with 1,800 pounds of coal per day, and with a large increase of power. Before this boiler was provided with attachments, it required two 40 horse-power boilers and 2,800 pounds of coal. The engine is a 140 horse-power low-pressure beam engine. No repairs of brick-work around furnace or doors is required, and it is said not to have given any trouble since it was first put in. We present herewith Prof. Thurston's conclusions *verbatim*, from an extended report on the performance of this boiler:

"CONCLUSION.

"From the average results of the trial, it is concluded:

1st. That the horizontal tubular boiler tested at Faber's Pencil Works, Greenpoint, having the Stead bridge-wall steam generator attached, exhibited an unusually high evaporative power, and equivalent to:

(*a*). 10.26 pounds of water per pound anthracite coal, from and at 212° F.

(*b*). 11.67 pounds of water per pound combustible, thus utilizing 78 per cent of the heat generated by the combustion of the fuel.

2d. That the boiler exhibited a steaming capacity equivalent to 3.03 pounds of water evaporated per square foot of heating surface per hour, from and at 212° Fahrenheit, which, on the basis of 31 pounds, or ½ cubic foot, of water to the horse-power, is equivalent to a duty of one horse-power from each 12.33 square feet of heating surface, making the capacity of the boiler 62 horse-power. This is also exceptionally good.

3d. That the amount of priming, as measured, 0.26 per cent, is remarkable for a boiler having no superheating surface. The absolute amount of water primed is so small as to warrant the

statement that the steam made was, practically, thoroughly dry. Very respectfully, R. H. Thurston."

Respecting this test, Mr. Stead writes us that it "was made before the last improvements were made to the circulating generator. Had it been made after they were on, it would show at least one pound more of water evaporated."

The following comparative test at Tecumseh Mill No. 2, Fall River, will also be found of interest:

Fired by Fireman 6 Years in employ of Co., who fired as usual.

Details of Evaporative Test, Tecumseh Mill No. 2, Fall River.	Old Setting.	Stead's Generator.	Stead's Generator—Side pipes.
Duration of trial in hours	8	8	8
Mean temperature of feed-water degs. F.	150	150	150
Mean pressure of steam in pounds	89	90	90
Total weight of water evaporated from a Temperature of 150° Fah., in pounds	11,701	15,401	17,000
Total weight of water which would have been evaporated from a temp. of 212° F.	13,023	17,141	18,921
Total weight of coal consumed in pounds.	1,650	1,700	1,800
Pounds of water evapor'd per lb. of coal.	7.09	9.06	9.44
Pounds of water evaporated from and at 212° Fah.	7.93	10.08	10.51
Total amount of grate surface in sq. ft.	32	32	32
Pounds coal consumed to each sq. ft. of grate surface per hour	6.43	6.63	7
Gain in economy for Stead's generator.	...	26 p.c.	32.53 p.c.
Gain in capacity for Stead's generator.	...	31.46 "	45.28 "

We have not space to give further extracts from records of tests, but the above may stand for fair samples of their tenor, since all are very favorable as regards economy of fuel, increase of steaming capacity, and durability in service.

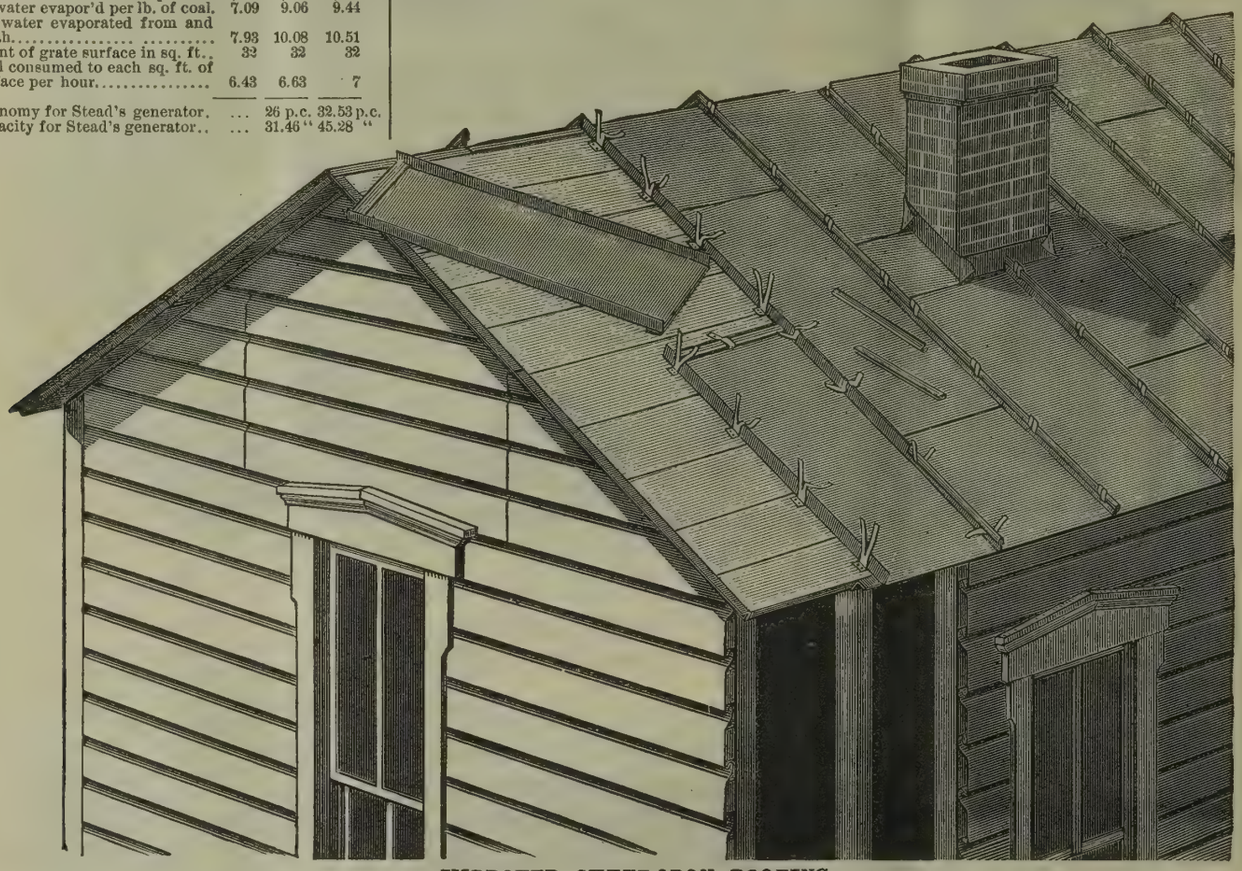
While these devices will be found advantageous under all circumstances, they will be found to be specially valuable in localities where increased steam capacity is necessary, but where additional boilers cannot be introduced for want of space. Such cases are of frequent occurrence, and may be amply provided for by the introduction, at small expense, of the Stead attachments, which require but a day or two to put in place, and may save the room and cost of a second boiler and fittings.

Mr. Stead states to us that when his invention was first introduced, complaint was made that parts of the apparatus were faultily constructed. He has since then made arrangements to obviate these objections, by having the bends, T's, elbows, etc., that he employs, made specially to order, and capable of withstanding a pressure of 3,000 pounds per square inch.

We should mention, in conclusion, that before contracting for new boilers with circulating generators, the inventor makes hollow walls for the double purpose (1) of saving the wall from cracking, and (2) for heating the air before carrying it to a perforated pipe back of the bridge wall, to insure a more perfect and intense combustion. The gain from this last provision, which is doubtless not inconsiderable, has not yet been carefully estimated. The pipes and fittings for these attachments are made specially to order, to insure their quality and strength.

We are informed that there are some 300 of these attachments in use throughout the country, many of them at prominent establishments. In addition to the locations already mentioned, we may name the Morgan Iron Works, New York; Colgate Soap Works, Jersey City; Roebling & Sons, Trenton, N. J.; Equitable Life Insurance Co., 120 Broadway, New York; and Pencoyd Rolling Mills, Manayunk, Pa.

Our readers will be afforded all further information respecting these devices by addressing the inventor, J. C. Stead, 102–106 West street, corner Kent, Greenpoint, Brooklyn, N. Y.



IMPROVED SHEET-IRON ROOFING.

Sheet-Iron Roofing and its Advantages.

When made of first-class materials and properly put on, roofs of sheet-iron are admirably adapted to withstand fire, wind, weather and accidental contingencies that affect the durability and quality of such coverings. Roof coverings of sheet iron are manifestly superior to many other forms. As compared with shingles, they have the advantage of being far more permanent, free from the liability to the warping and shrinking which soon develop leaks in shingle roofs, and they are free from the fire danger, to which the latter are notoriously subject. As compared with slate, which is popular in many quarters, a sheet-iron roof can be made more thoroughly storm-proof, as the material admits of being fitted more closely and snugly to irregularities of the roof than the former; it is not liable, as slates are, to be cracked by frost, or injured by the falling upon it of heavy objects, and is free from the liability of cracking and splitting, which, in the event of a fire, often impairs the fire-protective qualities of a slate roof, and which is specially manifested when cold water is thrown upon them while highly heated. As compared with tin roofs, those of sheet-iron have all the advantages of the former, and in addition are made of heavier sheet, and the method of making the seams generally adopted with iron roofing dispenses with the necessity of soldering—one of the troublesome features of the tin roof. The seams in a tin roof are so small and narrow, that as soon as the contraction of the metal breaks the solder the seams will leak.

We show in the accompanying cut an illustration of a very simple and excellent form of sheet-iron roofing, made by A. Northrop & Co., of 97 First avenue Pittsburg, Pa., which appears to combine all the advantages which have been claimed for this species of roofing. The manufacturers of this product state that the iron they use is equal in quality to that employed for tin plate, and that it is twice the weight of the latter. The method of attaching the separate sheets is shown in the cut, and is at once simple and effective. The sheets are turned up at the sides, and a forked metallic strip nailed to the roof timbers is bent over each to hold them firmly in place; the joint is then covered with a snugly fitting cap piece, over which the projecting ends of the metallic fastening strips are turned down, firmly fastening the sheets laterally. The ends of the sheets are engaged by means of a close fold, the upper end of each sheet being first clamped down to the roof boards with a metallic strip. The laying of the roof is, therefore, so simple an operation that any mechanic of ordinary intelligence can put it on with the instructions furnished.

To prevent condensation of moisture on the under side, the manufacturers recommend that a layer of a lining felt, which they prepare for this purpose, be laid beneath it for protection. They also recommend for use on their roofs a form of preservative paint, the superiority of which they have amply demonstrated.

The advantages of this roofing on the score of convenience and durability in service, will be manifest from the foregoing description. When iron roofing has not proved satisfactory, it can almost always be traced to a neglect of some important requirement. Much of the iron roofing in the market is made from a common iron, with very porous texture, and the surface frequently painted with inferior oil or paint having in it a large proportion of benzine driers.

There are at present not less than 2,000,000 square feet of this roofing in use in various parts of the country, some of which has been in service as long as 20 or 25 years, giving in all cases the fullest satisfaction.

New Electrical Machinery.

In continuation of the description in our last issue of machinery and apparatus for the electric light, we present herewith a further contribution to the subject, in the form of some novelties in this class of machinery, devised by the same inventor, Mr. Hiram S. Maxim, and manufactured by the United States Electric Lighting Company, 120 Broadway, this city.

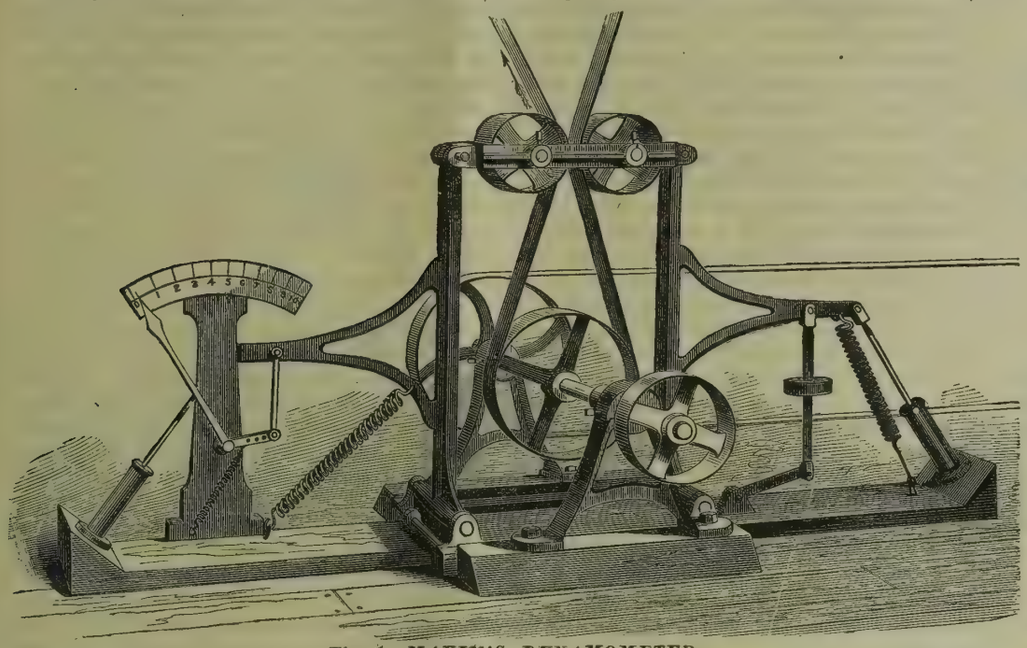


Fig. 1.—MAXIM'S DYNAMOMETER.

It is a matter of importance, in using electrical machinery, to be able to measure accurately the power consumed by it, and for this purpose Mr. Maxim has devised the form of dynamometer, or power measurer, shown in Fig. 1. This apparatus is driven by a driving pulley above, not shown in the engraving. The belt passes in contact with two small guiding pulleys, suitably mounted in the upright frame shown in Fig. 1, and around the central pulley of the counter-shaft. This frame is pivoted upon the base piece below, and is therefore free to move in the direction of any impelling force. The generator—the power to drive which is to be measured—is placed in connection with the dynamometer by a driving belt passing over either of the two outer pulleys of the counter-shaft. A pointer moving over the face of a graduated arc, is connected by simple mechanism to an arm extending from the vertical frame. By this means any deflection of the pivoted vertical frame is measured by the corresponding movement of the pointer.

So long as there is no load on the dynamometer, the framework is equally balanced, the pull on both sides of the central belt being equal. But when the generator is attached by the belt to either of the outer pulleys in such a manner as to drive the counter-shaft in the reverse direction, there is a resistance to the motion of the counter-shaft, the belt of the central driving pulley will exert an unequal pull upon it, since one side will be pulled by the generator pulley and the other side correspondingly slackened. In obedience to this disturbance of equilibrium, the unequal strain on the small guiding pulleys above will deflect the pivoted framework in the direction of the pull, and the amount of the deflection will depend upon the difference in the stress between the tight and slack sides of the belt. This deflection is the measure of the resistance to the rotation of the counter-shaft, or, in other words, the power required to drive the generator. The indications of the pointer are such as to give this power in terms of horse-power (and fractions), or in foot-pounds.

Fig. 2 represents a form of compound dynamo-electric machine or generator, devised by Mr. Maxim for special purposes. It will afford two separate currents, entirely independent of each other, or the same may be coupled either for quantity or intensity. The machine is, therefore, capable of being varied in its applications. It may be used to furnish two large electric lights, or one very large one; or it may be used to give a current of great electro-motive force for other scientific or experimental purposes. The economy of power and performance of the Maxim machines have been well attested, and require no special comment from us in this place.

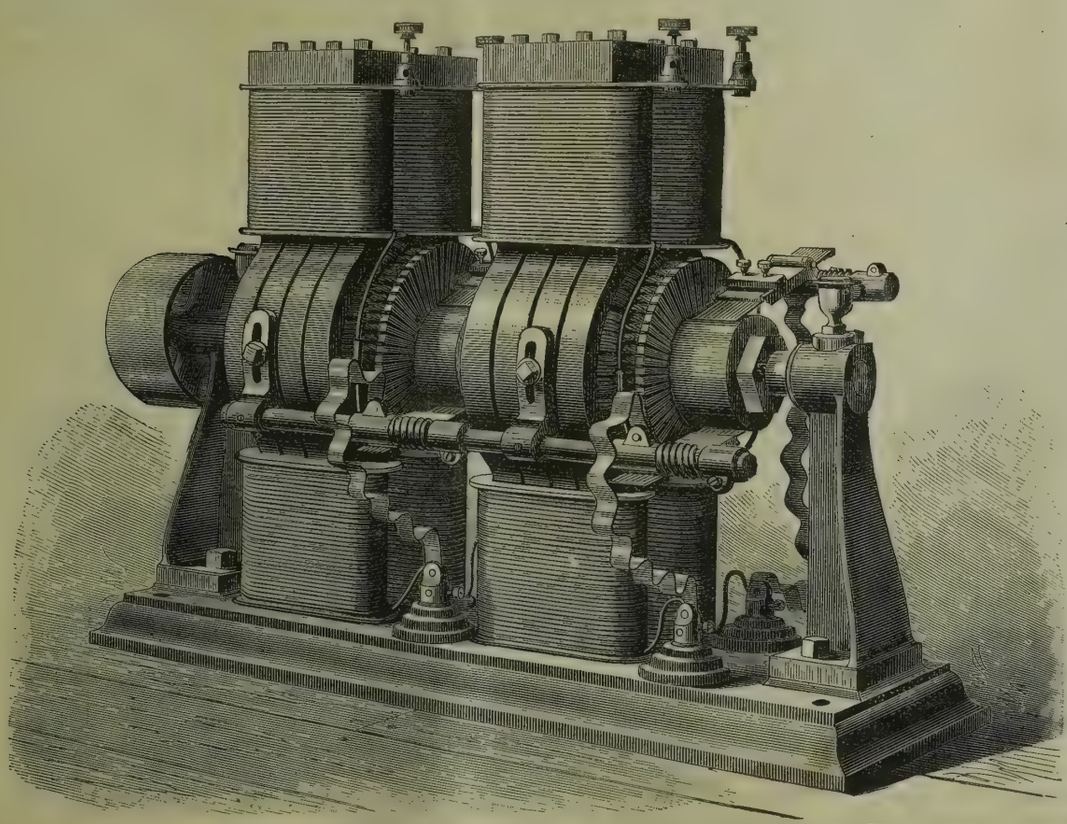


Fig. 2.—MAXIM'S COMPOUND DYNAMO-ELECTRIC MACHINE.

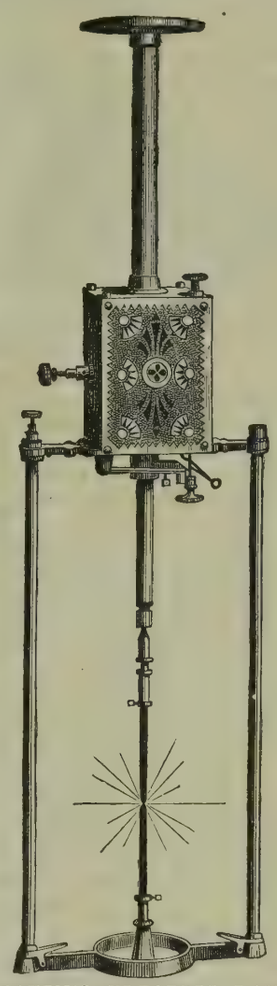


Fig. 3.—MAXIM'S ELECTRIC LAMP.

Fig. 3 represents a convenient form of electric lamp, devised by Mr. Maxim specially for the use of factories, workshops, stores, etc. The regulating devices for controling the light are enclosed in a neat and ornamental case of bronze. The side rods are telescopic, permitting the bottom to drop, and thus facilitate the removal and replacement of the glass globe that surrounds the light.

Further information respecting the above described machinery may be obtained on application to the company.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

A chapel is being added to the rear of Grace Church on Broadway.

R. H. Macy & Co. have made a large additlon to their store, at the corner of Sixth avenue and Thirteenth street, and it is now ready for occupancy.

Arthur Crooks is preparing plans for the church and parsonage of the Sacred Heart, to be erected on Fifty-first street, between Ninth and Tenth avenues, at a cost of about $100,000.

On the corner of Madison avenue and Thirty-ninth street, this city, a picture gallery and library are to be built for Wm. E. Dodge, Jr. The building will be of brick and stone; the interior finish is to be of oak, in the old English style; cost, about $25,000.

The directors of the company who are to build the Opera House for this city have decided to obtain plans for the same, through the medium of a limited paid competition. J. C. Cady, Geo. E. Harney, Potter & Robertson, and Geo. B. Post are the selected competitors.

The massive walls of the First National Bank building, at Broadway and Wall street, attract much attention. The brown stone walls are left rough-dressed to a great extent, and the huge chocolate-color blocks have a fine effect. The building is now advanced to the third story.

At West Farms, New York City, a Catholic church, 70 by 36 feet, to seat 300 persons, is to be built from designs by Arthur Crooks. It will be of brick, and have an open timber roof, traceried windows. The front gable is to be surmounted by a bell turret, 70 feet high; cost, about $6,000.

The New York Central & Hudson River Railroad Company will build a freight shed at the foot of Sixty-fifth street, North River. It will be 98 by 420 feet, and will cost $30,000. The same company will also erect two, five and six story brick warehouses, 100 by 200 feet, on Twelfth avenue, each to cost $90,000.

Arthur Crooks has prepared designs for the church and parsonage of St. John the Evangelist, to be built on Fifty-fifth street, corner of First avenue, this city. The church will be 80 by 125 feet, and will seat 1,500 people; it will have a spire 214 feet high. Materials to be used will be brick, with Ohio and blue-stone finish. The style is fourteenth century Gothic; cost, about $70,000.

Two elegant brown stone houses are being erected on Fifth avenue. One is at the southwest corner of Forty-ninth street, and is owned by Ogden Goelet. Its dimensions will be 50 by 100 feet, and will be five stories high, with a Mansard roof. The estimated cost is $175,000. A somewhat similar dwelling is being built at the southeast corner of Forty-eighth street, by Robert Goelet. It will be 50 wide, 91 feet deep and five stories in hight, with a Mansard roof. The estimated cost is $175,000.

One of the finest business blocks in the city is soon to be erected in the wholesale grocery district, at Duane and Hudson streets. It will be 101 feet wide by 78 deep, and will comprise eight stories and a mansard roof, the whole rising to a hight of 92 feet. Piles have been driven for the foundation, and it will be built of hard brick and Wyoming stone, and be provided with iron shutters. The building is to be erected partly for the use of the owner, Leopold Schepp, the celebrated manufacturer of prepared cocoanut.

The addition to the Astor Library, on the north side of the old building in Lafayette place, of which we have already made mention, is nearly completed. It is of similar style to the present building and is 65 feet wide and 100 feet deep. It is three stories in hight and surmounted by a peaked roof. A continuous corridor runs the entire length of the library on the first floor and doors are provided in convenient positions on the upper floors between the different sections of the building. The cost of the improvement is about $200,000.

Two first-class houses on the north side of Fifty-seventh street, between Fifth and Sixth avenues, have just been finished by E. D. Connolly and Sons. The houses are of brown stone, four stories and basement, and are each 25x91.6 feet. They have bay windows on the first and second floors. The dining-room, trimmed with mahogany, is very unique. The effect of this room, with its beautiful encaustic tiles, ornamental hearth and the floor inlaid with mahogany and ash, is strikingly elegant. Flanked, as it is, by two butler's pantries, all provided with statuary marble and ample closets for silverware, it presents a complete picture of comfort and luxury. It is artistic and excellently designed and executed. The back parlor is trimmed in walnut, the front in rosewood, with ample and well carved sliding doors. The newels and twisted balusters are all of mahogany. The second floor, arranged in ample chambers, is trimmed in walnut and cherry. Here, too, are encaustic tiles in the hearths with carefully selected designs, the saloon style of toilet-room and dividing the front and back rooms with an ample supply of mirrors over all the basins and statuary marble everywhere. The third floor is in ash and cherry, constructed on the same principle as the lower floor. On the upper stories are the servants rooms, with an ample billiard room in front, provision having even been made for the cue racks. There are double stairways throughout these houses. Electric bells everywhere, dumbwaiters and lifts for trunks are supplied in both houses.

A very tasteful building has been begun at No. 55 Broadway, and is to be finished next April. H. H. Houston, of Philadelphia, is the owner, and Babb and Cook of this city are the architects. The building will be narrow and very high, but the façade, as shown by the architects' drawings, will be a considerable ornament to lower Broadway. The lot covered is twenty-seven feet wide and two hundred feet deep, extending through to New Church street. The building will cover the whole of it, fronting on both streets, and will be five stories high above a massive basement story, which will be three steps down from the sidewalk level, and there will also be a cellar and sub-cellar. The ground falls eleven feet from Broadway to New Church street, and the cellar underground at the former street will be almost entirely above ground at the western end. At the bottom of the Broadway front will be a band of North River blue stone. Then will come alternate courses of Philadelphia pressed brick and red sandstone from Carlisle, England. These will continue, with the addition of a moderate use of terra cotta, up to the second story. On the north side of the front will be the main entrance of the building, which will lead up twelve stone steps to the corridor and thence to the elevators and staircase in the center of the building. Over the chief entrance will be a lintel and pediment of carved sandstone. The windows of the first story will be very large and the transoms over them large also. At the top of the first story a stone course enclosed by two projecting cornices will span the front. The main division of the façade above the first story will be made by three splayed brick piers running through the second, third and fourth stories, where they will be crowned by simple capitals from which arches will spring connecting the piers. The top story will be a succession of round arched windows, and the whole will be crowned by a stone cornice, above which will be an open parapet of stone, brick and terra cotta. Iron beams and hollow brick arches will render the walls fire-proof, and the building will be heated by steam.

A party in this city who is at the head of a large manufacturing company, but whose name we have not been able to learn, has filed plans and specifications in the Bureau of Buildings for a family hotel to cost, exclusive of the ground, $1,000,000. The structure is to be erected on Eighth avenue facing the Park and extending along the block from Seventy-second to Seventy-third streets. It will have a frontage on the avenue of 204.4 feet and a depth on the side streets of 210 feet. The building, which will accommodate forty-two families *en suite*, will be eight stories high. The foundation walls will be laid on solid rock from 10 to 18 feet below the curb level, and will be from three to four feet thick, of blue stone laid in cement mortar. The thickness of the first story walls will be 24 inches; those of the second, third and fourth stories 20 to 24 inches; those of the fifth and sixth stories 16 to 20 inches, and thence to the roof 12 to 16 inches. The walls on the Seventy-second and Seventy-third street sides will be of Haverstraw brick, coped with free and blue stone, while the Eighth avenue front will be of brick and Dorchester (Nova Scotia) stone. The roof—of iron and stone, fire-proof—will be peaked, and in it there will three sky-lights. There are to be seven elevators, with steam boilers and apparatus to run them. The basement will be occupied by janitors, servants and their families. Upon the first floor will be the office, a spacious public restaurant and a cafe for the accommodation of the tenants in common. Each floor is divided into six suites for families, and will include a parlor, library, dining-room, kitchen, several sleeping rooms, bath-room, store-room, trunk-room, servants' room and closets. A broad entrance on the first floor leads into a spacious open court, from the four corners of which iron fire-proof stairs extend to the halls on each story, and thus offer easy access to the roof. While the apartments are so arranged that each family has all the facilities for housekeeping and isolation from other tenants, the public restaurant, cafe and parlor on the first floor can be used in common by all. It is probable that the hotel will be ready for occupancy on the 1st of May next.

Miscellaneous.

A jail will be built this season at Salem, Ind., at a cost of $15,000.

A new station will be built at Eagle, Pa., by the Pennsylvania R. R. Co.

A glucose factory, for which $500,000 have been subscribed, is to be built at Ithaca, N. Y.

A brick elevator, cable of holding 2,500,000 bushels, is being erected at Brooklyn, N. Y.

A school-building is to be erected at Council Bluffs, Iowa, to cost $29,000. C. F. Driscoll architect.

The Board of Education of Moorhead, Minn., is to build one large and five small school-houses.

D. K. Dean, of Erie, Pa., is the architect of the new town-hall at Franklin, Pa., to cost $12,000.

D. W. Gibbs, of Toledo, is preparing drawings for a court-house at Marysville, O., which is to cost $90,000.

In Massilon, O., Russell & Co. are building a warehouse which is to be 243 by 66 feet, and four stories high.

One of the largest grain elevators in the country has just been completed at St. Paul, Minn. It cost $150,000 and has a capacity of 1,000,000 bushels.

Charles L. Carson, architect, of Baltimore, is preparing drawings for a Presbyterian church, to be built at Catonsville, Baltimore county, Md., 35 by 60 feet; cost, $4,000.

Jordan, Marsh & Co., of Boston, are extending their retail premises, covering about 5,000 additional feet of ground. The new fronts will be constructed of Belleville stone. The octagonal end, at the corner of Washington and Avon streets, will be seven stories high. The work is now in progress, and will cost about $100,000. S. J. F. Thayer, of Boston, is the architect.

Besides the three hotels at Long Branch, N. J., to be built by John Hoey, R. J. Dobbing and Judge Hilton; Samuel A. Lewis, of 294 Broadway, and David Davies of the New York Cotton Exchange are now examining plans for the erection of a large hotel on Helmbold Block. The structure will be of brick, 500 feet long and four stories in hight, and on the side street it will present a front of 400 feet on Ocean avenue, and will be three stories in hight. The ground floor is to be used for stores.

Improved Ventilating Skylights.

We supplement our recent description (see page 53 of our March number) of the improved ventilator and chimney caps, made by Messrs. S. J. Pardessus & Co., of this city, by a description in detail of the method of constructing the skylights to which the parts above named are useful adjuncts.

The utility of these appliances for securing simply and certainly the lighting and ventilation of apartments will be obvious on inspection of the illustrations.

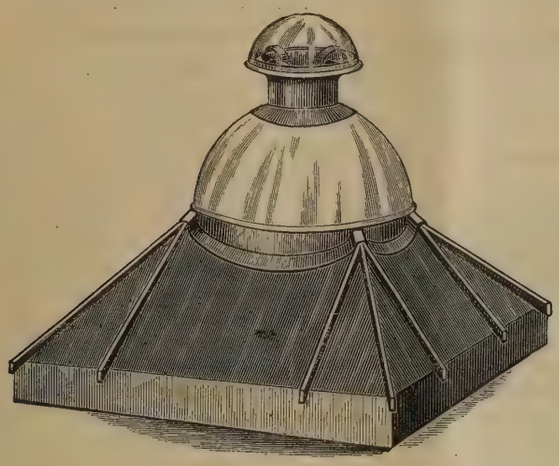


Fig. 1.

The principle on which ventilation is secured is the simplest that can be devised; the ventilating action is perfectly automatic, and when necessary, can be controlled in degree by opening or closing a damper provided for the purpose. For further information respecting this feature of Mr. Pardessus' device, our readers are requested to consult the article above referred to. The skylight and its attachments are built with the special design of securing strength with durability, as will be apparent further on.

We illustrate herewith several forms of these skylights. Fig. 1 represents a glass exhaust dome skylight. The dome is cemented to a socket base of galvanized cast-iron, in such a manner that the joint is protected from the action of the weather. To this base piece the bars or rafters of a hipped skylight are tightly fitted into sockets provided for the purpose, and the glass at the upper joint is sunk into a sheath filled with cement, thus making the best mechanical provision for insuring strength to the structure, and for guarding against leakage. This style of skylight is made either square or oblong at the curb or base, and of any size, from 4 to 12 feet or upward, as may be desired. It is surmounted with a ventilating cap, with either metal or glass top.

Fig. 2 shows a skylight similar in general arrangement to that above described, but differs in the detail that the socket base is surmounted by a ventilating cap of glass or metal in place of the glass dome and cap of the other. In this case, too, the ventilating tube has a greater capacity. Figs. 3 and 4 represent respectively a square and an oblong base skylight, provided with galvanized cast-iron socket hoods, with ventilating caps either of glass or metal, and of varying sizes to suit special requirements.

The makers lay special stress upon the peculiarities of their skylights, which are designed in such a manner as to combine the maximum of strength with durability in service.

Further information respecting these manufactures will be furnished on application to S. J. Pardessus & Co., 9 and 11 Park Place, New York.

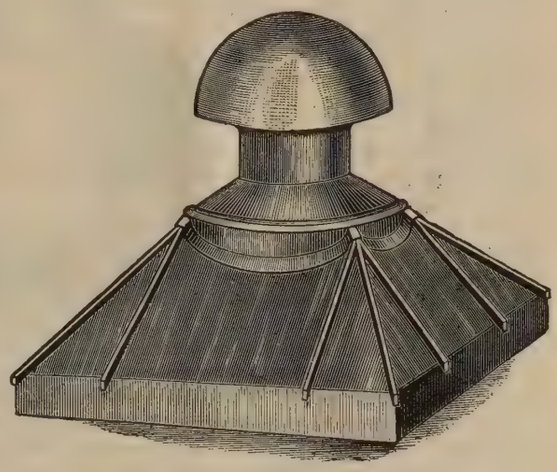


Fig. 2.

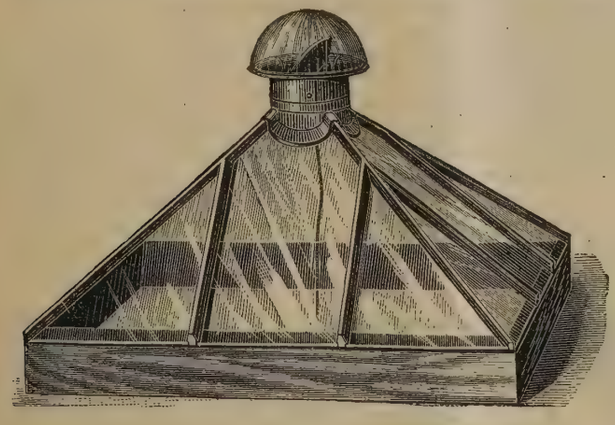


Fig. 3.

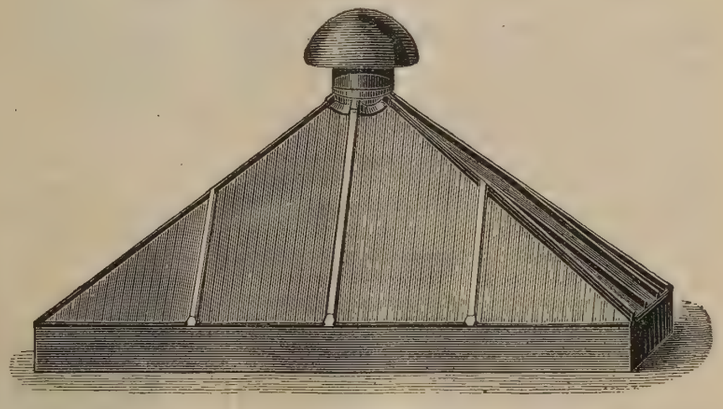


Fig. 4.

Artificial Amber.

Articles made of artificial amber are now produced in immense quantities and of beautiful appearance, and sold for the natural material. The resembling substance thus employed is principally colophony—a resin obtained by the decomposition of turpentine—though many other ingredients are also made use of to give it the requisite qualities. So perfect is the imitation said to be, that the false substance has the electrical properties of the true; and some ingenious fabricators have even managed to introduce into the substance foreign bodies—insects, etc.—to render the similarity more striking. The means of detection are simple. Genuine amber requires a heat of 545° to 550° Fah. to melt it, while the spurious substance becomes liquid at a much lower temperature. Again, while the true article is only slightly attacked, after a very long time, by ether and alcohol, the imitation rapidly loses its polish in contact with such liquids, and soon becomes soft. True amber pieces of small size may be formed into a lump of much greater value by moistening the surfaces to be united with caustic potash, and pressing them together while warm.

Malleable Nickel and Cobalt.

Herr Fleitmann, a German metallurgist, made the observation some time ago, that the addition of a few per cent of metallic magnesium to nickel and cobalt had the effect of rendering these metals, which are usually quite intractable to manipulation, both malleable and ductile. This he explains on the supposition that the magnesium removes from these metals certain impurities in the form of oxide, which they carry in the ordinary course of their preparation.

He has since found that an alloy of nickel, with about 5 per cent of zinc, is of itself somewhat malleable, and that this alloy may be rendered completely so by the addition of as small a quantity as one-twentieth of one per cent of magnesium. The resulting metal is so readily manipulated that it may be welded to itself, or to iron and steel. Messrs. Fleitmann & Witte have rolled plates of nickel two feet wide, and have made nickel-faced sheet-iron and steel by welding plates of their deoxidized nickel alloy to those of iron and steel. These observations have a very practical bearing on the future applications of nickel in the arts.

American Mining Methods.

A well-known Comstock engineer, after having made a tour of inspection through the mining districts of Germany, has reported his conviction that there is no engineering in that country at all to be compared with that on the Comstock lode, and no mines in which the mechanical appliances are so ingenious and effective. His account of the crude and primitive methods in use in many localities is very graphic.

He reports, for example, that in certain deep mines in Bohemia, the hoisting apparatus consisted merely of open tubs, and the operating machinery was so poorly constructed that he dared not descend. In most of the German mines, he adds, the men are compelled to walk up and down to the scene of their labors, either by an incline or by using long parallel stilts which move up and down alternately about 6 feet at a time. The mode of ascending and descending on these is to step from one to the other, as each ascends or descends, where a misstep would be certain death. His remark that in the Comstock the men went up and down to and from the lowest levels in two minutes, was received with polite incredulity. He refers to the mining tools employed in the same uncomplimentary terms, and asserts that an average day's work on the Comstock would seem incredible to the miners of continental Europe.

High-Speed Engine.—Mr. Edison is reported to have ordered a very powerful Allen engine, from the Southwark Works in Philadelphia, with which he hopes to be able to drive his electrical generator with better results than hitherto, with special reference to his electric railway, lately illustrated in this journal.

Explosion of a Horizontal Tubular Boiler.

We select for illustration this month, from the record of the Hartford Steam Boiler Inspection and Insurance Company, the case of a horizontal tubular boiler which exploded some months ago in an Ohio flouring-mill with disastrous effect to life and property. In this case the direct cause of the explosion could not be determined with certainty, although the subsequent investigation of the accident, which brought to light the facts narrated in the following account, sufficed to make it reasonably sure that there were only two probable causes of the explosion: Either the presence of a crack in the seam, the fracture of which initiated the explosion; or over-pressure from a defective or badly managed safety-valve.

From the following narration of facts it will appear that the boiler had never been inspected by a competent person, which is sufficient to account for the fact that an explosion in this case occurred, for it is scarcely conceivable that an intelligent inspector would have failed to detect a defective seam, or to advise the owners and engineer in charge either to replace or how to properly manage a safety-valve. These conclusions appear to be reasonably demonstrated in the history of the case, which is given below.

The boiler was, as shown in the engravings, of the horizontal tubular type. It was set in brick masonry, and externally fired in the usual manner, having the furnace under the right-hand end (see Fig. 1). There appears to have been links, one at each side, near the summit of the shell at the front, as though this end had been suspended from a support above the boiler, while the absence of brackets on the sides of the shell indicates that the rear end rested on a support below the boiler. The furnace gases passed under the boiler, heating its lower half, and returned through the tubes to the smoke-arch formed by the extension of the shell in front, thence upward through a rectangular opening in the shell to the chimney. The age of the boiler is not positively stated, but it had occupied its late position in this new brick mill but little, if any, more than a year, its predecessor having blown the old wooden mill into kindling-wood only about eighteen months before. It was, therefore, probably about one year old; but it had not been examined by any competent inspector since it was set up in the mill.

The dimensions, as far as ascertained, are as follows: The shell was 14 feet long by 58 inches diameter, made of $^{5}/_{16}$-inch plates, single riveted. On the rear end was a steam dome having a flat cast-iron top, on which were the main steam attachment and the safety-valve. The steam gauge-pipe was screwed into the side of the dome. There were two man-holes, one in the rear tube plate above the tubes (Fig. 3), and the other in the front head below them (not shown in the cuts). The working pressure was not given in the report. There were indications observed by the inspector who reported this accident, that grease from the engine had found its way through the open feed-water heater (so-called) that was used in connection with it, into the boiler; but there were no indications of low water, although the explosion was popularly attributed to this cause.

Since the disaster, time enough has elapsed in which to carefully compare the phenomena with a number of apparently similar cases where well-defined weakness of a longitudinal seam was the defect from which the explosion originated, and the conclusion is naturally arrived at that there was a crack between the rivet holes of the inner lap of the seam A B, Fig. 1, caused by the use of the drift-pin, or by some other violence in forming the seam, or that the ends of the plate were not brought to the true curve of the cylinder, thus forming a flattened arc at the lap, and the effort of the internal pressure to form a true cylinder, and the converse tendency of the plates to return to the distorted form on the pressure being relaxed, would cause an increasing weakness which would after some time develop a crack on the line of least section. Whether or not this is the true solution in this case, the conclusion that there was a weakness at this point, or an over-pressure, is inevitable. If there was a congenital weakness, it would increase until an ordinary pressure would bring about disaster; on the other hand, if there was an extraordinary internal pressure, it must have been something like 250 pounds to the square inch to have broken a square seam. In any event, there can be no question as to the value of timely and intelligent personal inspection; for if there was a detectable defect at the seam, where they are most often found, then this is the place that would be most carefully scrutinized. Excessive pressure can only occur in case of a badly constructed or badly managed safety-valve, and who knows so well as the experienced inspector how to detect any of the above-named defects, and prevent, if his advice is followed, the disastrous effects of over-pressure, careless management, and bad workmanship.

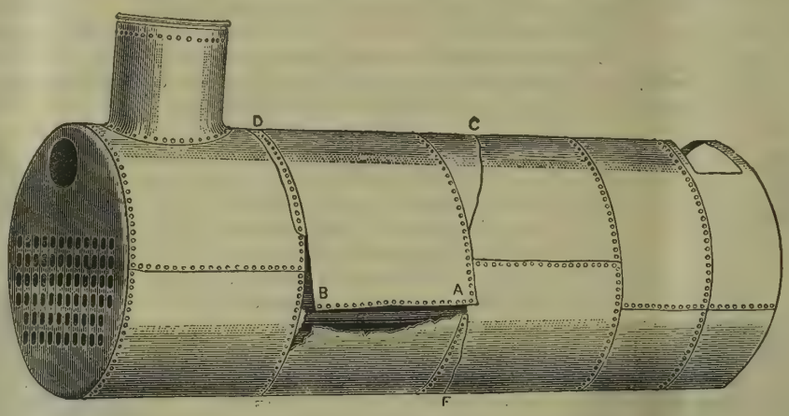


Fig. 1.—A B, line of initial fracture; A C, A F, B E and B D, lines of secondary fracture, being the boundary lines of the detached ring plates.

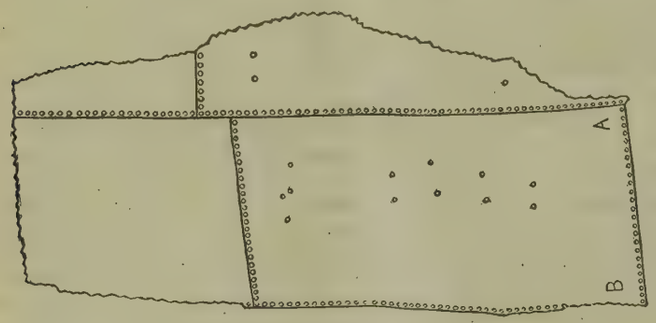


Fig. 2.—Ring of plates broken off by the force of the escaping water and steam.

Fig. 3.—The rear end and tubes.

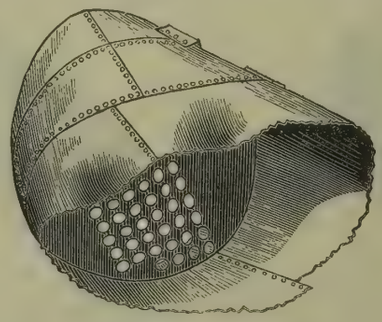


Fig. 3.—Front End of Boiler.

Niello Work.

This beautiful class of work, which is so much made in Russia, and especially in the Caucasian provinces, is a sort of enameling upon silver with a paste consisting chiefly of the sulphide of the metal itself. The following account of the process is given by Dr. Percy: Take 5 drams of silver, 2 ounces and 4 drams each of copper and sal ammoniac, 3 ounces and 4 drams of lead, and 12 ounces flour of sulphur. Make a paste of the flour of sulphur and water; put it into a crucible; afterward melt the metals, and pour them into the crucible which contains the paste; re-cover this vessel in order that the sulphur may not take fire, then calcine over the fire until all the superfluous sulphur is driven off; afterward finely pulverize the mass, and make, with the addition of a solution of sal ammoniac, a paste, which introduce, by means of rubbing, into the parts intended to be enameled; then clean the article, and place it in a furnace where it is sufficiently heated to melt the paste which fills the engraved parts and make it adhere to the metal. That done, moisten the article with a solution of sal ammoniac, and heat it in a muffle to redness, after which you may rub and polish the article when it has become cold, without fear either of altering or of detaching the enamel. It remains always of a very fine black color.

Dangers to Ocean Cables.

In enumerating the dangers to which ocean cables are liable, Dr. Preece says that the chief cause of accidents, next to that of anchors, is due to the abrasion of the cables on rocky bottoms. The bottom of the sea is frequently of an undulatory nature, and the cable remains suspended from point to point, and at such points the wire becomes chafed and worn away, and speedily decays. Sometimes the cables rest on corrosive stones, copper ores and iron stones, when corrosion sets in and causes the cable to speedily fail. Volcanic action sometimes damages cables, as also rock slips; icebergs, too, frequently carry large pieces of rock, which fall to the bottom when the iceberg thaws, and in their descent are liable to fall across a cable. Finally, and in addition to lightning, earth currents, etc., there are also faults due to imperfect joints, which are owing to accidents of one kind or another, that pass inspection during the process of manufacture, but

which slowly develop themselves after submersion or lapse of time.

The Ashcroft Self-Cleansing Steam Trap.

We give in the following an illustration and description of a very practical and useful form of steam-trap, invented by Mr. E. H. Ashcroft, of Boston, and which has demonstrated its utility by an extensive introduction.

The construction and action of this apparatus will be understood from the following description, reference being made to the accompanying engravings, of which Fig. 1 shows a longitudinal section, and Fig. 2 a plan. The apparatus, it will be observed, is extremely simple in construction, a fact which constitutes one of its distinguishing merits. It consists of a metallic reservoir A, provided with inlet and outlet pipes, and with a loose cover, which may be removed whenever it is desired to inspect the action of the trap. The reservoir is filled with water to the level of the outlet. The inlet pipe is provided with a plug-cock C, which is affixed in the side of the reservoir, and which controls the admission of water of condensation, or steam, to the chamber. To insure the equable expansion of the plug-cock, and its easy working at all times, it is surrounded with a steam jacket. The opening and closing of the plug-cock, and consequently the action of the trap, is determined by the rise or fall of a copper vessel D, closed above, but open below. This vessel is hinged at the side at the box, and, by its rise or fall, according to the varying pressure to which it is subjected, acts automatically as a key or lever, opening the cock C when the condensed water accumulates in the steam pipes, and closing it so soon as the water of condensation has been discharged. The only part of the apparatus that is expected to wear is the plug-cock C, and this is adjustable so as to present a fresh wearing surface as may be required. It can be removed for re-grinding, and when worn out, can be replaced by a new one at trifling cost.

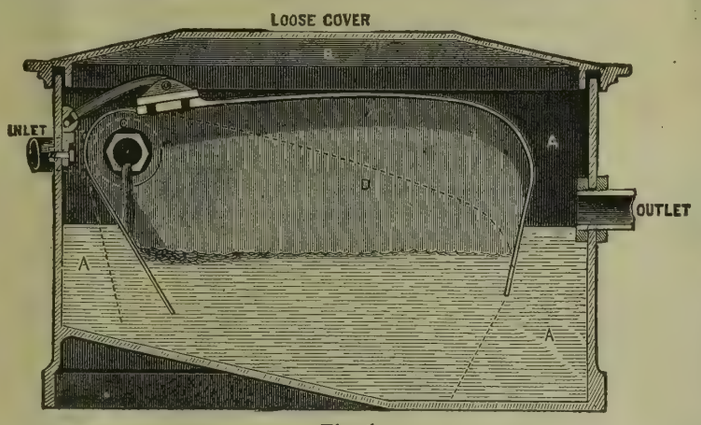


Fig. 1.

For fixing the apparatus, the makers recommend that it should be placed as low as possible, that the condensed water may gravitate into it. The trap itself should be set truly level, the inlet pipe should have a fall towards the trap, and the overflow pipe a good fall away from it. The satisfactory working of the apparatus can be assured by adjusting the set-screw on the slide-valve until the apparatus discharges properly.

To test its working condition from time to time, the air-valve shown in cuts should be raised from its seat to ascertain that steam escapes therefrom. It is necessary to observe the precaution whenever the vessel D is turned back out of the water, to lift the air-valve for an instant after replacing it, to allow the trapped air to escape, which otherwise would interfere with the action of the apparatus.

The apparatus is designed primarily for permitting air and water of condensation to escape from steam pipes without loss of steam; but it is recommended as being applicable for the same purpose to high and low pressure steam engines, steam presses, steam hammers, drying cylinders, steam worms, sugar pans, and to steam apparatus generally.

The makers present the following summary of the meritorious features of this trap: 1. It is entirely open to the atmosphere, and therefore accessible for examination, even while under working pressure. 2. It is practically self-cleansing; as the water of condensation falls directly into the reservoir A, any scum or sediment settling to the bottom is swept away by the first rush of water upon starting. 3. It will work equally well at high or low pressure. 4. Its extreme simplicity and durability—enclosed ball-floats, flange joints, holding-down bolts, levers, stuffing-boxes, etc., being all dispensed with. 5. Its action and working condition can be always seen and tested by simply lifting the loose cover B. 6. A freer discharge for the air and water of condensation than is possible with any other trap. 7. It is thoroughly reliable, there being ample power to open or close the plug-cock C, which is surrounded with a steam jacket, to ensure equal expansion throughout, and therefore easy working.

The following testimonial, from the Treasurer of the Maine Insane Asylum, at Augusta, where 18 of the Ashcroft traps are in use, is a fair specimen of the many commendatory letters which the manufacturers have received:

MAINE INSANE HOSPITAL, TREASURER'S OFFICE,
AUGUSTA, August 26th, 1880.

THE ASHCROFT M'F'G CO., 53 Sudbury Street, Boston, Mass.:

Gentlemen: We are just in receipt of yours of 25th inst. We have eighteen of your steam traps in use, including several sizes. Some have been in use upwards of two years, and all as long as one year. We consider them the best traps we have ever used. They are entirely automatic, and perform their work in a very satisfactory manner.

You are at liberty to use this letter wherever it will be useful to you. Yours very respectfully,

C. B. LARKIN, Treasurer.

Additional information will be furnished on application to the Ashcroft Manufacturing Co., 51 and 53 Sudbury street, Boston, Mass.

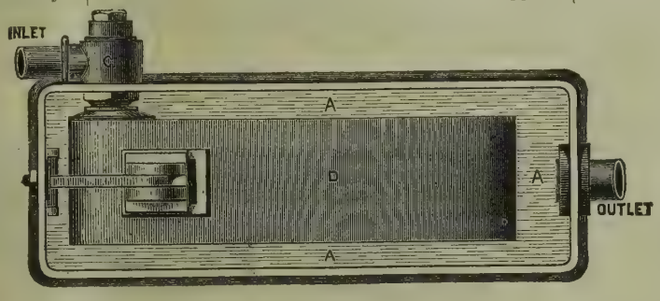


Fig. 2.

Asbestos Products.

It is only of late years that systematic efforts have been made in the direction of utilizing asbestos for industrial purposes, and Mr. H. W. Johns, of this city, the pioneer in the attempt to establish the manufacture of useful products from asbestos on a commercial scale, by dint of perseverance in the face of difficulties that is deserving of the highest praise, has achieved a notable success. As is the case with most industries, after the work of creating a market and a demand for new products has been accomplished, Mr. Johns has had many imitators, but his name has been so intimately identified with asbestos for years, and his manufactures have attained such a general recognition for excellence, that when one hears or speaks of asbestos products, it is taken for granted, unless special mention to the contrary is made, that Johns' products are meant. Mr. Johns has three distinct branches of asbestos manufactures, which are specially worthy of notice; these are respectively, asbestos roofing, boiler coverings, and paints. We devote in what follows a few lines of description respecting each of them.

The asbestos roofing of Johns is a very useful and practical application of asbestos. It is manufactured in the form of a flexible sheet, resembling leather, and consists, first, of an upper layer of asbestos-coated felt, beneath which is a layer of fire and water proof composition, into which asbestos enters as an ingredient; then follows a strong canvas, then another layer of the fire and water proof asbestos composition, and lastly a manilla lining. These materials are compressed in the process of manufacture into a thin sheet, and produced in continuous rolls about 40 inches wide and containing about 200 square feet. Its weight is about 50 pounds per 100 square feet, or about one-tenth that of gravel roofing. The mode of applying it is simply to tack it to the boards, and is attended with no difficulties. When laid, the roofing is coated with a special coating prepared for the purpose—a species of asbestos paint. This roofing forms a smooth, water and air tight surface, which is a good non-conductor of heat, and practically fire-proof; it is adapted for all climates, and is especially intended for roofs of large buildings, such as factories, warehouses, railroad buildings, etc.

Mr. Johns' applications of asbestos as a boiler and steam-pipe covering are of several forms. One method consists in applying a cement mortar containing asbestos in a flocculent condition, resembling paper pulp, directly upon the boiler or pipes, which compound, when it has set, forms a good non-conducting and fire-proof covering Or the process is modified by applying a turn or two of a lining felt composed of asbestos, and applying the cement upon that. Or several alternating layers may be employed, as desired. The asbestos lining felt is also used in connection with hair felt forming fire-proof air-chambers, which are asserted by eminent practical engineers to be the most effective non-conducting coverings known.

Last, but not least in importance of Mr. Johns' asbestos manufactures, are liquid paints, which are especially designed for dwellings and other exposed wood and iron structures. These paints are in use upon the finest buildings and most extensive structures in this country, and have been adopted by the several departments of the United States government, which, in addition to the fact that they command a higher price than any other paints for structural purposes, is a sufficient guarantee of their quality. They are manufactured of a great variety of shades, to suit special requirements, and are prepared ready for the brush.

Further information respecting these and other asbestos products, may be obtained on application to the H. W. Johns Manufacturing Co., 87 Maiden Lane, this city.

A PROFITABLE RAILWAY.—The shortest and most profitable railway in the world is probably to be seen at Coney Island—the Marine Railway—connecting the Manhattan Beach Hotel and the Brighton Beach Hotel. It is 2,000 feet in length, is laid with steel rails, and has a handsome little station at each end. Its gauge is 3 feet. The cost of this miniature road, including stations and equipment, was $27,000. The operating expenses are $30 a day, and the average receipts are $450 a day the entire season, $500 being sometimes taken in. The fare charged is 5 cents. The property paid a profit last year of 500 per cent on its cost.

Recent experiments by Piazzoli appear to establish the fact that the tenacity of iron increases on magnetization.

The Possibilities of the Electric Railway.

The highly interesting practical experiments of Dr. Werner Siemens, of Berlin, and of Mr. Edison, in constructing and operating a railway with electrical motors, have attracted universal attention by reason of the novelty of the idea to the present generation, and the apparent success of the experiments; and much speculation has been indulged in as to the possible

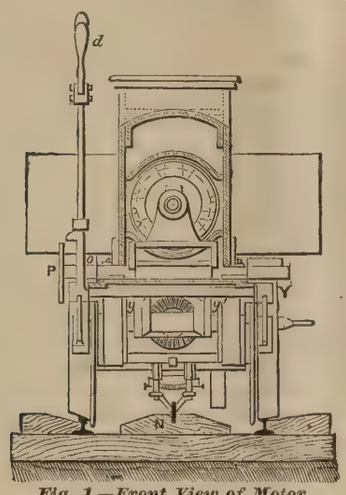


Fig. 1.—Front View of Motor.

future utility of this latest application of electricity. From the results that have been reached in the preliminary experiments of both the inventors above named, we risk very little in advancing the opinion that the practical success of the new method of propulsion has been demonstrated both from a technical and economical standpoint, and we may reasonably expect to see the system extensively introduced in the near future for mining and agricultural purposes, and in our cities for the transfer of passengers and goods. For the purposes above named, and doubtless for others that do not on the instant occur to us, the advantages of electricity as a motive power over steam and animals, is too pronounced to admit of question, and the economy of the new method having been once established (which we think may safely be assumed), the general introduction of the electric method of propulsion for the hauling of ores and minerals, for plowing and other agricultural work, and in cities for the transport of passengers and goods, and for postal and freight service, is simply a question of time. We anticipate that the electric railway will grow speedily into popularity on the strength of its introduction in a few prominent localities where its advantages over steam and horses in the absence of noise, freedom from liability to many forms of accident now unavoidable, and from the annoyances of flying sparks, cinders, grease and other dangerous and offensive accompaniments of our present elevated steam roads, would strikingly demonstrate themselves. And should the anticipations of the advocates of the electric railway for our cities, as a substitute for the surface passenger roads, and for the transaction of much of the package and freight traffic over thoroughfares now thronged with vehicles, be realized, the single advantage that would be gained in the improvement of the sanitary condition of our cities in ridding us of the vast bodies of filth with which our streets are daily littered, can hardly be overestimated.

The history of the electrical railway resembles that of the majority of important and revolutionary inventions, in that several abortive attempts at its realization are recorded before its actual success was assured. Nearly forty years ago, the idea occurred to Prof. Page, one of the pioneers of electrical invention, and some years later Mr. Silby and Dr. Colton essayed the problem. But these early experimenters lacked the means for the economical generation of electricity with which our inventors of to-day are provided, on which account they failed. The only source of electricity available at that time, was the galvanic battery, the inconvenience, uncertainty and costliness of which was an insuperable obstacle. The development of the dynamo-electric machine within the past few years, however, has removed this serious difficulty from the path of inventors, and has given them what before was lacking, namely, a comparatively cheap means of generating and maintaining powerful electrical currents by the direct conversion of mechanical energy (no matter how generated, whether by steam, wind or water-fall) into electricity. In this form we can send our power to great distances over metallic conductors with comparatively little loss, drive electric locomotives or electric engines located at distant points, to do the work of the steam engine in our factories and workshops, or furnish light to towns and cities. Upon the development of the dynamo-electric machine, the electric railway has been made a possibility of the near future, and unless the signs of the times are most deceptive, we look for the most extensive adoption of the system in the course of the next decade.

Dr. Werner Siemens, of Berlin, whose name we mentioned at the outset of this article, is entitled to the credit of having revived in practical shape the forgotten efforts of Page and others of the past generation, by constructing and operating an experimental electrical railway in the grounds attached to the Berlin Exhibition of 1879. As this ingenious invention promises at no distant day to have a historical interest, we present herewith illustrations and a description of his apparatus and plans, together with some practical suggestions of the inventor that have grown out of the same.

The electric railway requires, first, a dynamo-electric machine at the terminus of the road, which is actuated by some source of power—say a stationary engine. This machine is placed in electric connection

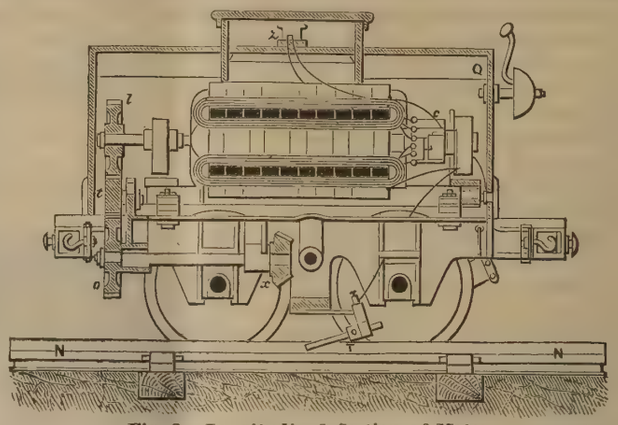


Fig. 2.—Longitudinal Section of Motor.

by metallic conductors with a second dynamo-electric machine, which, properly mounted on a vehicle, the wheels of which are set in motion by it, constitutes the electrical locomotive. Thus we have the first dynamo-electric machine set in motion by the steam engine at the terminus, the electricity generated by it is conveyed by the rails, or by some special conductor, to the second dynamo-electric machine, which it sets in motion, and actuates the locomotive. These are the essential parts of the electric railway. The details of Dr. Siemens' system are as follows: Fig. 1 represents a front view of his locomotive, and Fig. 2 a longitudinal section. The motion of the electrical machine is communicated by suitable gearing to the wheels of the vehicle on which it is mounted, and these are placed on rails of the ordinary construction. The electricity from the driving electrical machine at the station is conveyed to the locomotive through a special insulated central rail (seen in Fig. 1), the current being taken from the insulated rail by a metallic brush, and returned to the first machine through the ordinary uninsulated rails, thus completing the circuit. The stationary machine, it should have been stated, has one of its poles connected with the track rails and the other with the insulated center rail. The current, therefore, comes through the insulated center rail, traverses the metallic brushes in contact with the center rail, passes through the wires of the locomotive, and returns through the wheels and track rails.

Fig. 3.—SIEMENS' ELECTRIC RAILWAY AT THE BERLIN EXHIBITION.

Fig. 3 shows a perspective view of the locomotive drawing three cars, each containing six passengers. The current is thrown on or off by the driver, who sits astride of the motor and controls its motion. The performance of the locomotive here described, and which

was capable of developing 8¼ horse-power, attained a maximum of 7½ miles per hour, carrying 18 passengers.

Dr. Siemens' novel experiment attracted so much attention, that the suggestion was subsequently made to construct an elevated electrical railway in the city of Berlin for the transfer of passengers, which, we are informed, has been received with favor by the municipal authorities. He also developed the idea of employing the same system as a substitute for the pneumatic postal service, in use in that and other European capitals, between central and outlying postal stations, to facilitate the collection and distribution of the mails.

We give below illustrations and a brief description of these suggestions, which seem to be in a fair way to be realized. It is proposed to construct the columns of the elevated electrical railway of wrought iron, placed on the edge of the sidewalks at distances of 10 meters apart. The longitudinal supports T T (Fig. 4), on which the rails S S (insulated from each other) rest on sleepers of hard wood, are firmly fastened to the columns. The passenger coaches are to be constructed as lightly

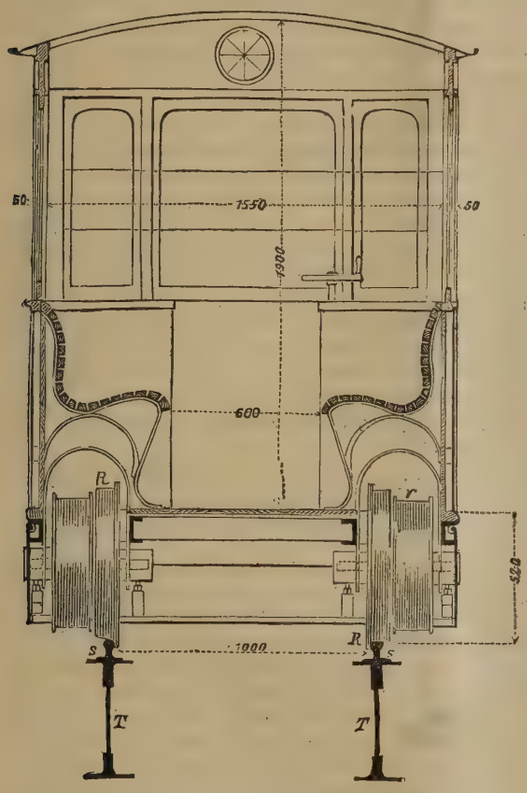


Fig. 4.—Siemens' Electrical Elevated Railway.

as is compatible with safety, and are designed to seat 15 persons. Each wheel is carried on an independent axle, and the axle boxes of each side are electrically connected. The two driving-wheels R R receive their motion from the dynamo-electric machine, which is placed under the bottom of the vehicle. The central rail in this plan is dispensed with, and the track itself is made the conductor, the plan being similar if not identical with that of Mr. Edison's, described in the June number of this journal.

Fig. 5 represents a special arrangement designed for postal service, by the same inventor. The road is proposed to be carried on short iron columns S. On these rest the wooden sleepers, to which are attached sheet metal pieces b^1 b^2, forming the side walls of an inclosed railway. Between these sheet metal strips, at suitable distances apart, are placed light wooden cross-ties, on which rest the light rails a^1 a^2. Of these rails, one is placed at frequent intervals in electrical connection with the side sheets, which are covered above with a removable sheet-metal cover *d*, while the other is connected with all the iron columns. It is designed to run small four-wheeled wagons on this road by suitable electrical connections.

We are thus in a fair way to see this interesting branch of electrical invention speedily developed.

Tin Discoveries in Maine.

From Maine comes the report, and on very trustworthy authority, of very promising discoveries of tin, which, if verified by subsequent developments, will prove to be of great importance. Thus far we have no tin mines in the United States; a few traces of this metal have been found here and there, but thus far the amount discovered has been trifling, and up to the present time all the tin that is consumed in this country by the immense industries employing tin and tinned iron, is imported from abroad—chiefly from England. The importance, therefore, to the whole country of the discovery of extensive deposits of tin-stone, can hardly be overestimated, since it would enable our domestic industries employing tin, to become independent of foreign supply, and in time perhaps to compete with England in the manufacture of tin-plate, which consumes a large proportion of the tin that is produced.

The tin discoveries here referred to, are reported to have been made near the town of Winslow, a few miles from the capital of the State, where a number of veins of rich tin ore (cassiterite) are said to have been found in a rock formation similar to that in which tin is known to occur elsewhere. Prof. Hitchcock, who has examined the location of the reputed discovery, speaks very favorably of it. He states that the inclosing rock is a micaceous schist, cut by numerous veins of granite, in which latter the tin occurs, associated with other minerals. To be more specific, within a width of thirty feet of this micaceous schist, there are reported to have been noticed twelve granite veins, from ½ inch to 3 inches in width. These granite veins are said to be full of crystals of tin ore, associated with fluorspar, margarite, mispickel, beryl, lepidolite and other minerals. Prof. Hitchcock pronounces the Winslow mine, in its mineralogical, geological and physical features, to be "identical with those common to the stanniferous districts of Europe;" and he adds that "the ore seems to be sufficiently abundant to remunerate quite extensive outlays for mining operations."

Prof. Forrest Shepherd, who has examined the Winslow mine, also reports very favorably upon it. He is reported as saying that the veins are very favorably situated for working, and, what is particularly encouraging, that the Winslow deposits are at the surface, equal in quality to the best in Cornwall, while there and elsewhere the veins are rarely remunerative except at great depths.

We trust that the subsequent development of these deposits may justify the encouraging report of their surface indications. We shall not be long left in suspense, since the account from which we glean the foregoing statements adds the information that a company has been formed to develop the Winslow mine, and to extend the exploration for tin into other parts of the State.

Manufacture of India Rubber.

There are estimated to be about 150 manufactories of India rubber articles in Europe and America, consuming over 20,000 tons of raw material yearly. The largest consumers and manufacturers of rubber are the United States and England. The industry in this country has nearly trebled in magnitude within the last ten years, and our imports for the past three years averaged 12,307,520 pounds per year.

Great as this industry has become, it is probable that it is, comparatively speaking, still in its infancy, for not only are our totals of rubber manufactures increasing every year, but the applications of the material and of the products manufactured from it are steadily growing. The best rubber is that produced in South America, and from this source our manufacturers are chiefly supplied. The method of collecting the gum is exceedingly crude, and destructive to the trees, but the supply obtainable from along the Amazon may be said to be practically inexhaustible. The English have wisely decided to establish the regular culture of the rubber tree in their Indian empire.

Directions for Lacing Rubber Belts.

The belts should be placed on the pulleys as tight as possible. This can be best done by the use of belt clamps, except in the case of very narrow belts. In all cases the belt should be cut about one-eighth of an inch less than the distance around the pulleys with a tape line. The seam of the belt should always be on the outside. For narrow belts, butt the two ends together, make two rows of holes in each end (thus obtaining a double hold), and lace with lace-leather. For wide belts, put, in addition, on the back, a strong piece of leather or rubber, and sew or rivet it to the belt. If the belt should slip, it should be lightly moistened with boiled linseed oil—animal oil will ruin the

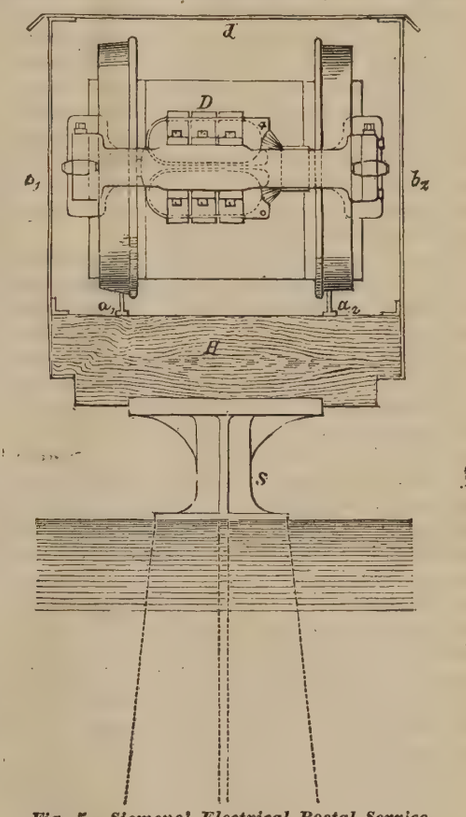


Fig. 5.—Siemens' Electrical Postal Service.

belt. If one application does not produce the desired result, repeat until it does. The belts will be greatly improved and their durability increased by coating the surface lightly with a composition made of equal parts of black lead and litharge, mixed with boiled linseed oil and Japan enough to cause it to dry quickly; the effect of this will be to produce a finely polished surface.

The Longest Tunnel in the World.

The Joseph II. mining adit, at Schemnitz, Hungary, begun in 1872 and finished last October, is now the longest tunnel in the world. Its length is 16,538 meters, that of the St. Gothard tunnel being 14,620, and the Mont Cenis tunnel 12,233 meters.

The object of the adit is the drainage of the important gold and silver mines at Schemnitz. It furnishes a geological section more than ten miles in length, and gives not only valuable information as to the downward prolongation of the lodes known in the upper levels, but some new ones have been traversed, and the entire series of rocks, with their mutual limits as well as modifications and occasional transitions, are disclosed without interruption. The entire cost of the tunnel was 4,566,000 florins—about $2,300,000. Its hight is 3 meters; width, 1.6 meter.

Scientific.

Meeting of the American Association.—The twenty-ninth annual meeting of the American Association for the Advancement of Science was held in Boston, commencing on the 25th of August, and was characterized more by the variety and number than by the originality or striking character of the papers read and discussed.

The address of the retiring president, Prof. George F. Barker, on "Some Modern Aspects of the Life Question," was one of the most interesting features of the meeting. Prof. Barker took the advanced ground, that, physiologically considered, life has now no mysterious passages, no sacred precincts into which the unhallowed foot of science may not enter, and that research has day by day diminished the phenomena supposed to be vital, and that sooner or later every action of the living body will be pronounced chemical or physical.

Prof. A. M. Mayer, of Hoboken, N. J., delivered an admirable eulogy on the late Prof. Joseph Henry. He reviewed the discoveries of Oersted, Ampère, and other investigators whose discoveries led up to those of Henry, and gave an account of the work of the latter, not omitting the practical results following therefrom. He instanced, in connection with Henry's services on the Light-House Board, one discovery—that lard oil, when heated to 280° Fah., is superior to sperm oil in fluidity and illuminating power—which saved the government not less than $100,000 annually.

The association received the report of a committee appointed to memorialize Congress and the State Legislatures on the important subject of the cultivation and preservation of our forests. The report was accompanied by a draft of a memorial which invites the attention of State Legislatures to the great and increasing importance of providing, by adequate legislation, for the protection of the existing woodlands of the country against needless waste, and for the encouragement of measures tending to a more economical use and proper maintenance of our timber supply, it being evident that the forests of the country are being used and wasted in a much greater degree than their restoration by natural growth. The committee recommended a law to protect trees planted along highways, and to encourage such plantings by deductions from highway taxes; also the passage of a law that shall exempt from taxation the increased value of land arising from the planting of trees where none were growing, for such period as may appear proper, or until some project may be realized from plantation; by appropriations of money to agricultural and horticultural societies, to be applied as premiums for their planting and for prizes for the best essays and reports upon subjects of practical forest culture; by encouraging educational institutions to introduce courses of instruction having reference to practical sylviculture; by laws tending to prevent forest fires; by imposing penalties against wilful or careless lighting of such fires, and enlarging and defining the powers of local officers in calling for assistance and in adopting measures for suppressing them; by establishing under favorable circumstances model plantations; and by the appointment of a Commission of Forestry under State authority analogous to the Commission of Fisheries.

Prof. Breneman described some experiments made with the view of obtaining new colors on common gray stoneware, and showed how quite a range of colors for decorating such ware—which is now only ornamented in blue—could be obtained. Messrs. Hovey and Henderson read interesting papers on aboriginal relics in caves, mounds, etc., which attracted much attention. Prof. Mayer described the construction and use of the topophone, an instrument of his invention, intended for locating the direction and position of sounds, intended for use on shipboard. Mr. E. B. Elliott made some instructive comparisons of the relative cost of the electric systems of lighting as compared with coal gas, for large areas, announcing the conclusion that the electric systems were to be preferred to gas. He compared the relative efficiency of several processes of electric lighting, showing the greater economy of the processes known as that of the "electric arc" over the "incandescent" system. By the electric arc one horse-power may produce a light equivalent to that from 1,200 to 2,500 standard sperm candles. By the method of incandescence, the results claimed by its friends vary from 107 to 255 standard candles per horse-power, averaging about 174. The electric arc and the incandescent processes, however, are not to be considered in the light of rivals, the former being especially adapted to the lighting of large areas, while the latter, so far as successful, is designed for small spaces—as for domestic and like purposes. Prof. Young described the methods in use at the Yale College observatory for testing thermometers and time-pieces.

The remaining papers were so purely scientific in character, that an abstract of them would be of little interest to our readers.

The association elected the following gentlemen to serve as officers for the session of 1881: President, Prof. G. F. Brush, of New Haven; Secretary, Prof. C. V. Riley, of Washington; Treasurer, Wm. S. Vaux, of Philadelphia. Cincinnati was selected as the place of the next annual meeting, which will be opened on the 17th of August, 1881.

Climate and Character.—An interesting summary of the opinions of a number of foreign savants concerning the influence of our climate in bringing out the peculiarities which distinguish the American character, is given by Mr. C. E. Young in a late issue of the *Sanitarian*. Dr. E. Reich, in noting the differences between the English and the Americans, although they are of the same race, is quoted as asserting that the differences in question are ascribable to the contrast of the climates of the two countries. The American atmosphere, he says, "is much too dry for the Anglo-Saxon race, and in point of heat too excessive; from this results the exaggerated nervous activity, the excesses of the national character, and the mad chase after the material things of the world."

Dr. Pettenkofer ascribes the nervous temperament characteristic of the American people, to the dryness of our climate. He has investigated the comparative loss of heat suffered by a person breathing moist and dry air, and finds that more heat is lost in the latter case than in the former, and that more is created. In consequence of this, the circulation is quicker and more intense, life is more energetic, and there is no opportunity for the development of an excessive amount of flesh or fat.

Essentially the same conclusions are reached by Dr. De Pietro Santa. Dr. Ludwig Büchner, a well-known German author, says that he has noticed among Americans a tendency towards the typical characteristics of the Indians—in face and form, gestures and movements. Dr. Carl Reclam compares the air of this country with that existing in elevated regions, its lightness and dryness producing substantially the same effects as the air of hights upon the physical and mental peculiarities of Americans.

Mr. Young finally gives his own conclusions in the the following language: "The dry air with us produces nervous, energetic, large-jointed skeletons, which have little or nothing in common with the stout, fresh, rosy, phlegmatic inhabitants of the mother country. Not only is the physical resemblance lost in the second generation, but the mental also, and ideas especially Britannic give way to ideas peculiarly American."

Some Facts about Jupiter.—The report of the Chicago Astronomical Society shows, during the past year, some good work done by Professors Hough and Colbert on observations of the planet Jupiter. With a magnifying power of 638 on the 18½-inch refractor, the disk of the planet was measured on eight nights by Prof. Hough and six by Prof. Colbert, the resulting values for ellipticity being respectively 1-16.23 and 1-16.73, sensibly smaller than Struve's value, though not differing much from other more recent determinations. The measures further showed "the figure of Jupiter's disk to be a true geometrical spheroid." Jupiter's belts were also carefully noted, and it was found that the middle of the great equatorial belt was subject to gradual change in its appearance between September 1st and November 1st. At first it was made up essentially of three separate belts, approximately of equal width; gradually it formed in two nearly equal portions, with a rift extending through a large part of the planet's circumference. The color of the equatorial belt was reddish-brown—brick color.

The red spot was studied from September 3d to February 10th. Its color was similar to that of the equatorial belt, but brighter, and appeared sensibly the same when only partially on the disk as when on the center. The mean value of its length at the center of the disk was 12″.73, and its breadth 3″.56 for Jupiter's mean distance; the length appeared to vary to the extent of 2 seconds, and the breadth about the same amount; but owing to the irregular outline of the object, it was difficult to decide whether actual change took place, or whether the discordances in the measures were due to indifferent vision. By observations extending from September 25th to February 10th, the time of sidereal rotation was found by Professor Colbert to be 9h. 55m. 34.2s.

Norwegium in American Lead.—A year or more ago Tellef Dahll announced that he had discovered a new metal in the nickel glance of the Island of Oterö, in the neighborhood of Kragerö. He found in this mineral nickel, cobalt, iron, arsenic and sulphur. In treating the precipitate by sulphuretted hydrogen with sulphide of ammonium, to remove the arsenic, a black sulphide remained undissolved. A thorough examination of this substance convinced him that it was new to science, and he proposed to name it Norwegium. He found it to resemble bismuth in being precipitated as a basic chloride by the addition of water, and in other respects, as the accompanying tabulation will show:

	Bismuth.	Norwegium.
Melting point	208°	254°
Atomic weight (R^2O^3)	210	218.9
Specific gravity	9.8	9.441

The chief point of chemical difference between them is said to consist in the fact of the solubility of the oxhydrate of the new metal in caustic alkali, as well as in carbonate of ammonia and soda on boiling.

Herr Prochaska has lately announced the probable existence of this new metal in American lead, having apparently detected it in the course of some examinations of American refined lead. It is suspected that the reddish or grayish tinge of the white lead made from certain kinds of American lead, may be due to the presence of slight quantities of this hitherto unknown and unsuspected impurity. At all events, the idea has been advanced since Herr Prochaska's statement has been published, and deserves investigation.

A Contribution to the Theory of Freezing Mixtures is made by A. Ditte, who shows, in a paper presented to the French Academy, that in cases where a lowering of the temperature follows the interaction of a hydrated salt and an acid, the result is the production of an anhydrous salt, and the liberation in liquid form of a large amount of water of hydration previously existing in the solid form.

He explains the production of cold, when Glauber's salt, for example, is mixed with hydrochloric acid, by the following reaction: $Na^2SO^4\ 10H^2O + HCl = NaCl + NaHSO^4 + 10H^2O$. He sought to verify his hypothesis by the production of freezing mixtures by rubbing together two salts, which, while possessing nearly equal thermo-chemical value (so that no heat would be developed by their reaction upon each other), should set free in their mutual decompositions, water of hydration, which, becoming liquid, must abstract heat from its surroundings and produce a freezing mixture.

In experimenting, he found, as an actual fact, that by simply rubbing together ammonium nitrate and Glauber's salt, a reduction of temperature amounting

to 20° C. (=68° Fah.) was produced; ammonium nitrate and sodium phosphate, rubbed together, caused a reduction of 18° C. (=64.4° Fah.); and ammonium nitrate and soda gave a diminution of 25° C. (=77° F.)

Plating with Copper on Zinc with cyanide baths, has the double disadvantage of being expensive and that the bath is highly poisonous. A decidedly preferable method, from all accounts, has been suggested by Hess, who proposes to substitute for the cyanide some organic salt of copper, and for this purpose he suggests the tartrate.

The bath is prepared in the following manner: Dissolve 126 grammes of sulphate of copper (blue stone) in 2 liters of water, and in another vessel dissolve 227 grammes of tartrate of potassa and 286 grammes of carbonate of soda in the same quantity of water. Mix the two solutions, and the result will be the precipitation of a light bluish-green tartrate of copper. This should be filtered and washed on a linen filter, and then dissolved in half a liter of caustic soda solution of 16° B., when it is ready for use. This bath, it is said, will give a smooth, coherent and tenacious coating of copper, which can be had of any desired thickness by continuing the action of the bath long enough.

The same author suggests that cyanide baths can be altogether dispensed with for plating with other metals, and the tartrates, phosphates, oxalates, citrates, acetates or other salts used as substitutes.

Bisulphide of Carbon is stated by M. Boiteau to have proved itself an effective remedy for the cure of the grapevine disease which of late years has spread with such disastrous results throughout the vineyards of France. The French savants have given much attention to the treatment of the vines, but thus far with very indifferent success. If M. Boiteau's statement is found to be verified, he will have proved himself to be a public benefactor. He asserts that the application of bisulphide of carbon to vines affected by the phylloxera has proved entirely successful. Diseased vines which were treated with this substance two or three years ago, look even better now than they did before they were attacked; and it seems to be established that the sulphide has no damaging effect on the productiveness of the soil.

Obstinate Neuralgia.—*La France Médicale* mentions several obstinate cases of neuralgia of the fifth nerve rapidly and completely cured by the administration of ammoniacal sulphate of copper. The formula employed is the following: Distilled water, 100 grains; syrup of orange flower or peppermint, 30 grains; ammoniacal sulphate of copper, 0.10 to 0.15 of a grain—to be taken in the course of twenty-four hours, especially after meals, in order to avoid irritating the stomach. The dose in question is the medium one, and is to be continued for from ten to fifteen days, even after the complete disappearance of the pains.

A Substitute for Wickerscheimer's Fluid, which is said to be an equally efficacious preservative, and to have the advantage of being non-poisonous, is suggested by Hager in the *Pharm. Ztg.*, as follows:

Salicylic acid	20 parts.
Boracic acid	25 "
Potassium carbonate	5 "
Dissolve in hot water	500 "
Glycerine	200 "
Then add: Oil of cinnamon, oil of cloves, each 15 parts, dissolved in alcohol	500 "

Hydrate of Chloral as an Antidote for Strychnia. In the *British Medical Journal*, Dr. George Grey reports a case of poisoning by strychnia successfully antidoted by administrations of chloral hydrate. The patient had swallowed 20 grains of strychnia, and was saved by the administration of two drachms of chloral hydrate in solution. In two days the patient was doing his usual work.

Salicylic Acid, in contact with wood fiber, is soon absorbed and decomposed. When used, for example, as an addition to drinking-water or to wine as a preservative, in wooden tanks or casks, its preservative influence speedily ceases, and no trace of the acid can be detected. For such purposes, therefore, casks and other vessels intended to receive salicylized water, wine and other liquids, should first be coated with pitch.

Extensive Glaciers, as large as the largest of those in the Alps, have been discovered on Cotopaxi, Chimborazo, Sincholagua and other less prominent Andean peaks.

Recent Discoveries Concerning the Currents of the Pacific.

Thomas Gray, of the London Board of Trade, has recently published some observations on the equatorial currents of the Eastern Pacific, which not only concern the navigator, but are of general scientific interest. From the *Herald's* account of his paper we learn the following facts: These observations were taken by Captain McKirdy, of the steamship "Peruvia," plying between Peru and China, and their results show, as Mr. Gray says, that some of the currents of the Pacific Ocean are not what they have hitherto been thought to be. The Admiralty charts, and almost all ocean charts, delineate a counter equatorial current north of the Equator and between the meridians of the Sandwich Islands and South America, and running eastwardly, instead of obeying the general westward impulse of all equatorial waters. In order to prove whether it exists or not, Captain McKirdy ran his ship from Callao to Honolulu on a straight-line course, and repeatedly found that the supposed counter current had no existence in the spring within the limits assigned to it by the charts, but, on the contrary, a steady current setting westward was met day by day. On the third survey of the ocean area, in which hydrographers have generally placed the equatorial counter current, when in latitude 2 degrees north, longitude 122 degrees west, an extraordinary change took place. In a four-hours' run the temperature of the sea went "down with a jump from 79 to 71 degrees, and the water changed color from a deep bluish-black to a dark, dirty green"—the former color and high temperature indicating unerringly the presence of the great westerly equatorial current, and the latter with the low tempera ture, the sweep of Humboldt's current, a vast flow from the Antartic basin which penetrates to the Equator and curves to the west of the Galapagos Islands. The able observer on the "Peruvia" had now conclusive evidence that his ship, to use his own words, "had been contending with a mighty river running partially through the Pacific Ocean to the westward."

Many years ago Lieutenant Maury said: "There are some of these equatorial currents in the Pacific which I do not understand, and observations are insufficient." The present results of McKirdy's explorations go far to clear up the long-felt mystery. That an equatorial counter current does exist somewhere in the broad Pacific is unquestionable, and Captain McKirdy recognizes its existence, though his researches necessitate a reconstruction of the charts which locate it. But the chief result of his labors is the discovery of the powerful westerly current of "deep, deep blue," easily distinguished from the bright, beautiful blue waters of the surrounding North Pacific, and detected by its temperature, but marked geographically by its irregular "horn-shaped" extension (one end pointing to Panama and the other to the Sandwich Islands). The explanation of this remarkable current is found in the southerly drift along the Californian and Mexican coasts of a body of water, possibly a continuation of the Japan stream, or Kuro Siwo. "This body of water," he says, "gets pent up in the Gulf of Panama; it cannot get south on account of Humboldt's current, which is constantly flowing north along the coast of Peru. It follows, then, that these two streams, each striving for the mastery, change their course to the westward, and rushing along side by side near to the Equator until they meet the equatorial counter current, which splits them like a wedge, the northern one preserving its 'deep, deep blue,' and the southern its 'dark, dirty green,' which clearly proves to be of extreme southern origin." This would explain the case of a Japanese junk cast upon the Sandwich Islands after a ten months' drift, moving on the great circle track of the "black stream," or Kuro Siwo, across the Pacific to the Californian and Mexican coasts, and thence westwardly. The newly noted stream will be of great value to the mariner, as in it the "Peruvia" made over 325 miles a day.

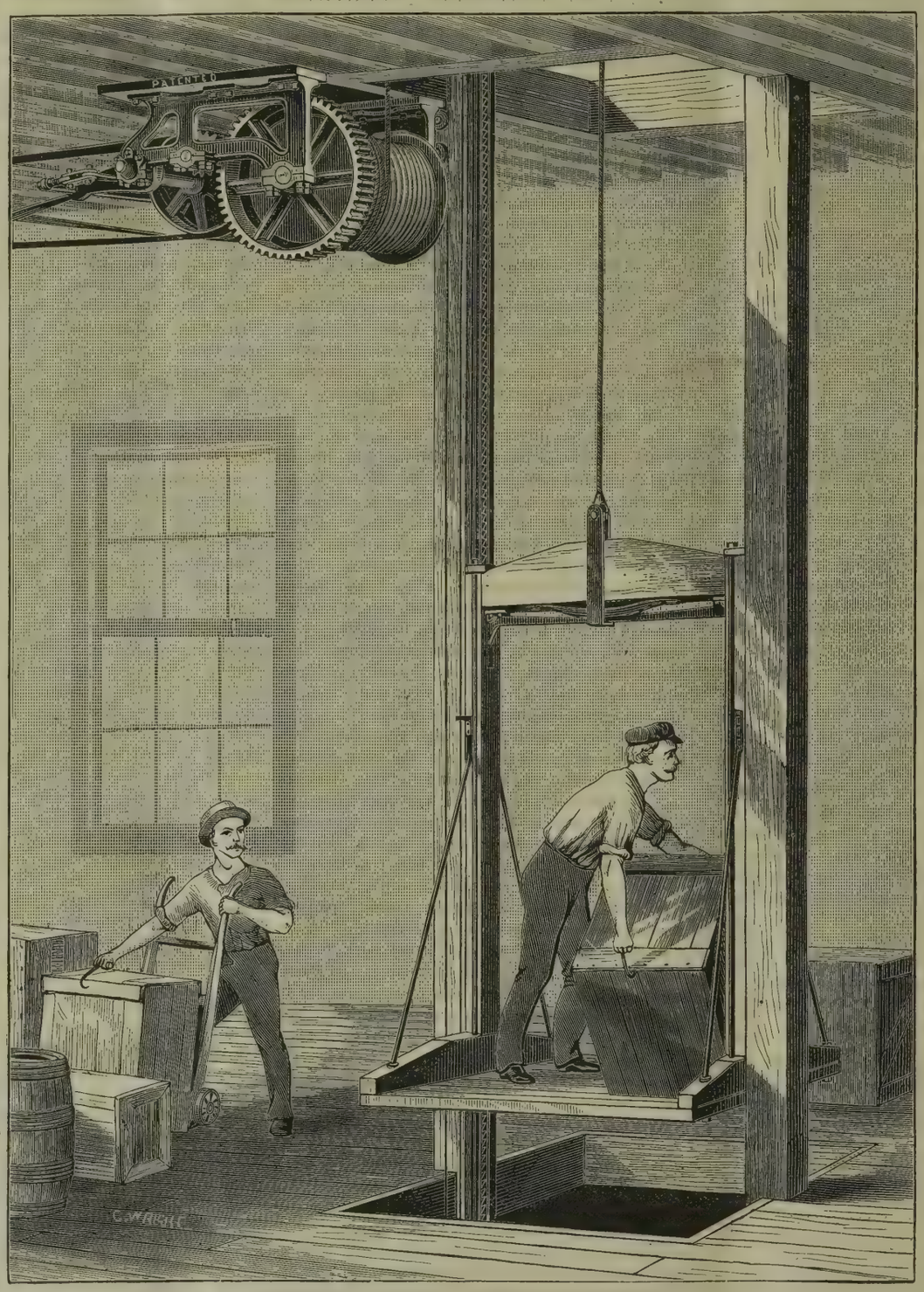
The Lost Continent—Atlantis.

From *Science for All* we glean the following interesting article: According to the ancients, there once existed in the Atlantic Ocean, opposite Mount Atlas, a great island adorned with every beauty and possessing a numerous population. Its princes were powerful, so that they invaded Europe and Africa, but by an overwhelming catastrophe the island was swallowed up in a day and a night. This legend is said to have been related to Solon by the Egyptian priests, and is given by Plato in the "Timæus." It probably had its origin in the existence of the Azores or the Canary Islands, which may have been visited by the Phœnicians. Our purpose is to prove that this fable has been far exceeded by the reality—that there once existed in the area now covered by the North Atlantic, an Atlantis of continental size, and of an antiquity compared with which Plato's island is but of yesterday. Some geologists are of opinion that North America was connected by land with Europe in middle tertiary (Miocene) times. The evidence upon which this theory is based is the resemblance of the existing plant life of North America to that which flourished in Western Europe in the Miocene epoch. The plants are supposed to have migrated from east to west by way of this imagined Atlantic land. It seems extremely unlikely, however, that so great changes in the physical geography of the globe should have taken place within times comparatively so recent. The deeper parts of the Atlantic are from 12,000 to 16,000 feet, and we require very strong evidence to convince us that such enormous depressions have occurred since a comparatively recent geological period. The migration of the Miocene flora may be more easily explained. The land connection between Europe and North America by way of Asia is broken only by Behring's Straits, which are very shallow; and a slight elevation would make it complete. That the migration has been from west to east, across Europe and Asia, receives confirmation from the fact that a flora similar to the North American has been discovered in Japan. It is, therefore, unnecessary to create an Atlantic continent to account for the migration of the Miocene flora. The continent of which we speak is of incomparably greater antiquity. No traces of it now remain, unless the submarine ridge, which runs down the Atlantic valley in about 50 degrees west longitude, be its denuded foundations. This ridge represents a great mountain range, rising 4,000 feet above the valley to the west, and 8,000 feet above the valley to the east; and reaching to within about 4,000 feet of the surface of the ocean. The Atlantic islands are not in any way connected with this ancient land. They are of volcanic origin, rising steeply out of a deep ocean, and are of comparatively modern date, the oldest strata contained in them being of middle tertiary age. The destruction of the old Atlantis strikingly illustrates the instability of the land. At an epoch inconceivably remote the Atlantic rolled as it is rolling now. Then a huge island raised its back above the waters, and, despite the hammering and grinding action of the waves, grew up into a continent, with river systems and great mountain chains. Rain, frost, ice and carbonic acid, were all the time at work upon its surface, eroding, filing, sawing, dissolving, softening, and washing down, till, after it had braved the elements for many successive epochs, it gradually wasted away, broke up into islands, and finally disappeared. The ocean reclaimed its ancient sovereignty, and its shores gradually assumed their present outline.

Cushing's Patent Safety Hoisting Machine.

As a supplement to our article in last month's issue of this journal, descriptive of the safety hydro-pneumatic elevator made by N. B. Cushing, of Jersey City, we give herewith an illustration and brief description of one of the several forms of geared-power elevators manufactured by the same maker. This style of hoisting machine is that which has received the widest introduction, and its extensive use to-day in all civilized countries is one of the best evidences that could be adduced in support of the excellence of its design.

The aim of the manufacturer has been to produce a compact and effective hatchway elevator. It is simple in construction, accessible in all its parts, safe in use, is readily stopped, started and reversed, and from the fact of the long-continued use of this type of machine, all the observed defects that have been noticed, have one by one been eliminated, so that it is now claimed to be the cheapest in first cost, the least expensive to keep in order, and probably the safest of all the various devices for the purpose for which it is designed.



CUSHING'S PATENT HOISTING MACHINE.

The hoisting machine is secured to the under side of the floor, in the most convenient place for the purpose, and is provided with a drum turned and grooved for the reception of the wire rope, self-oiling loose pulleys and boxes, sheaves turned for a wire rope, safety ratchets and pawls, wire lifting and operating ropes, and chains and connections. Where specially desired, there is added to the above a governor operating a safety brake, and a patent unwinding arrangement. The machine is made with wooden or iron frame, as may be desired.

From this description, and an inspection of the engraving, it will appear that the machine is characterized by excellent mechanical features, not the least of which is its simplicity, from which it follows that the claim of the maker, that it cannot well get out of order if it receives only ordinary attention, is fully justified. It is also claimed that these machines are built with the utmost care, being guaranteed against imperfect materials and workmanship. For special information, the reader is invited to address N. B. Cushing, Jersey City Machine Works, foot of Morris street, Jersey City, N. J.

GROWTH OF AMERICAN AGRICULTURE.—The enormous growth of our agriculture is shown by a writer in the *International Review*, whose figures, pending the publication of the census returns, may be accepted as trustworthy. Our authority says that in 1865 the wheat crop was 148,543,000 bushels; in 1879, 448,756,000. Corn in 1865 was 704,427,000 bushels, and in 1879, 1,544,000,000 bushels. Within 30 years the corn center has been transferred from the South to the West, and the wheat center from the Middle States to the West. The tobacco increase has, of course, been in the Southern States. Within the same period the cotton crop has increased from 3,012,000 bales to 5,216,000. Arkansas and Texas are the largest gainers from the increase in cotton. The total exports of all grains have risen from 39,000,000 bushels in 1878 to 189,000,000 bushels in 1879.

Sapphire Mines in Siam.

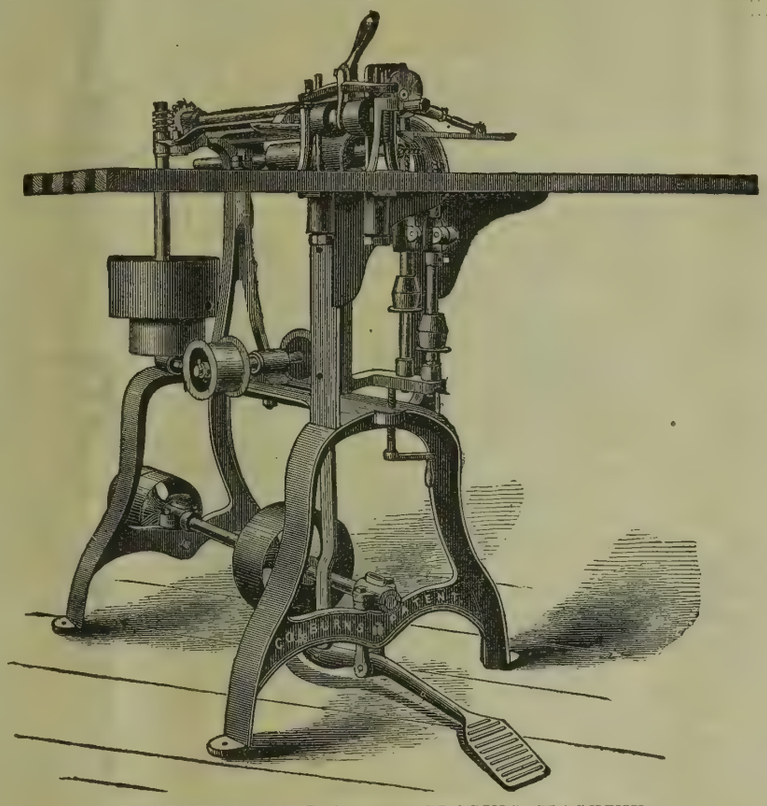
Five years ago a native hunter in Siam found sapphires in a remote and secluded district. Some men who were let into the secret, followed him to the mines, and brought back to Rangoon and Calcutta a number of very valuable stones. A rush ensued from British Burmah, thousands of adventurers flocking to the mines—some to find sudden fortune, but more to loose their lives from privation and jungle fever. The mines occur in the provinces of Battambong and Chantaboon. In his commercial report for 1879, the British Consul at Bangkok says that the miners are very careful to conceal their gems while in Siam. Being anxious to show some of the gems to Admiral Coote, the consul called for specimens from some miners who had just returned from the diggings. One miner, a poorly-clad and miserable-looking fellow, produced a few small stones, and, after a great deal of coaxing, was induced, with many precautions, to give a private view of his great prize, which was a very large sapphire in the rough, valued at $10,000. He would probably not have shown the stone at all had he not been on the point of leaving in a steamer. Owing to the secrecy thus observed by the possessors of valuable gems, it is impossible to give any estimate of the total value of stones found, but that individuals have made very large profits is certain. One man dug out a stone which he offered for sale in Chantaboon for $500, but did not find a purchaser. He went with it to Rangoon, where he was offered $7,500, but having awakened to the value of the stone, he declined to sell, and took it to Calcutta, where he eventually obtained $15,000 for it. Now, however, there are many experienced gem merchants established in the neighborhood of the mines, and something like the real value of the stones can be obtained by the miners on the spot. The largest sapphire hitherto found, so far as the consul knows, weighed 370 carats in the rough, and when cut turned

out 111 carats of the finest water. The ruby, onyx and jade are found in the district, but the quality of none of them is such as to make them very valuable.

Colburn's Improved Boring and Spacing Machine.

The accompanying engraving represents a machine which is well known throughout the United States and Canada as Colburn's boring and spacing machine. The inventor, Mr. L. S. Colburn, himself a practical mechanic, and feeling the need of an improved machine in his own shop, devised the machine originally for his own use; but finding it so well adapted to the wants of manufacturers of rolling blinds, among whom it speedily became popular, he has established a special manufactory for supplying the demand which has sprung up for them.

It was originally designed for boring the stiles to rolling blinds exclusively, and for this specialty is claimed to be unequaled by any competing machine. It has been recently improved by the addition of a horizontal arbor and bit, which adapts it to every variety of boring required in a sash, door and blind factory, and is now built from entirely new patterns, with superior workmanship and finish. The two vertical bits are used for blinds only, and will bore, without any previous marking or laying out, 8,000 holes per hour. The stiles, after being jointed, are placed upon the table, with a ratchet or pattern between them, the lower ends of the stiles resting against two blocks, which are securely fastened to the end of the pattern, and are moved over the bits by means of a pawl working in the notches of the pattern. It spaces its own work with perfect accuracy, at any distance apart, from 1 to 1¾ inches, and bores the entire length of the stile without stopping, hence no time is lost in stopping the machine to pass the lock-rail mortise, nor to lay out the work, as the boring is always done before mortising. The mortises are marked on the edge of the stile while the machine is in operation, from corresponding marks on the edge of a thin strip which has been previously laid off and tacked to the side of the pattern, and which can be replaced with any length required. The boring being done from the under side of the stile, the chips drop freely from the bits, and leave the holes of a uniform depth, so that the pivot of the slat may work on the end instead of the shoulder, which renders it less liable to bind or to become stuck fast by the paint.



IMPROVED BORING AND SPACING MACHINE.

We learn from the manufacturer that hundreds of blind makers, including some of the largest manufacturers in the United States, are using these machines at the present time with entire satisfaction. These machines were all placed on trial, with the guarantee that they should prove satisfactory or be returned; and they have, therefore, achieved their present popularity solely upon their merits.

Further details may be obtained on application to the manufacturer, L. S. Colburn, Oberlin, Ohio.

The Business Outlook.

The activity at present diplayed in all departments of business fully justifies the opinions expressed in our July issue. At no former period of our history has the country been blessed with a more favorable combination of circumstances to render it prosperous. The set-back of last spring proved, as we then acticipated, to be simply of a temporary nature, and from the noteworthy absence of speculation that has characterized the conditions of trade and commerce since then, we will not be far wrong in calling it "a blessing in disguise."

We do not know of a single existing circumstance affecting the present and prospective business interests of the country which can be construed unfavorably, and all indications point unmistakably to a long and uninterrupted period of prosperity before us. The harvests that have been gathered in are abundant; the transfers of agricultural products and of merchandize are taxing the capacities of our transportation companies to their utmost, and their earnings have of late reached unprecedentedly high figures. Our mills, factories and workshops are running on full time, with abundance of orders; the tide of emigration continues to flow to our shores, and scarcely a steamship reaches our ports of late but bears her tribute of European gold, to show how steadily and strongly the balance of trade has turned in our favor.

The demagogues who would fain have people believe, at every recurring Presidential election, that the country is sure to be ruined unless this or that party is successful, are raising their customary hubbub; but sensible people only laugh, knowing full well that whatever may be the result of an election, it will represent the will of the people, and that the current of business will flow on after it with scarcely a ripple on its surface. To stock-gamblers the cry of the demagogue about the unsettling of values, etc., is a godsend, but business men have just now neither the time nor the patience to listen to such nonsense.

Edison Again in the Field.

Those who may have concluded, from the absence of any newspaper discussion of the subject, that the ingenious and versatile Mr. Edison had abandoned the problem of electric lighting for domestic purposes, since the fiasco that followed the enthusiasm which his announcements of last winter aroused, may prove to have been mistaken. We throw out this comment from having observed in the latest number of the eminently respectable *North American Review*, an article in which it is announced, on Mr. Edison's authority, that the method of electric lighting with which his name is associated, has at length passed the experimental stage, and is now ready for public use.

Mr. Edison is said to have been quietly engaged for a number of months in overcoming the troubles and difficulties which the recent public trials of his electric lighting system had developed, and claims to have succeeded in doing so. We trust that Mr. Edison's confident expressions may be justified by the event, which we must await before the opportunity of passing judgment will be afforded. If Mr. Edison is fortunate enough to possess the quality of perseverance, his originality and versatility may yet crown his attempts to produce a practical, domestic electric lighting system, with success. So mote it be.

Protection and Cultivation of Forests.

In our notice of the proceedings of the American Association for the Advancement of Science, we refer to the action of a committee that was appointed to memorialize Congress and the State Legislatures on the importance of taking requisite steps to preserve and cultivate the woodlands of the country. This subject, save in the case of a few of the newly settled Northwestern States, has been almost wholly neglected in this country, and for want of proper safeguards our forests are rapidly disappearing.

The action of the Association on this subject is very timely and sensible, for the evil effects of the denudation of the forests are known to most persons of average intelligence.

Abroad the importance of protecting woodlands is so keenly appreciated, that there is scarcely a country of Europe where stringent laws on the subject are not in force; while many lands of the older settled Orient, that once were the garden spots of the earth, have, within the historic period, through the destruction of their woodlands, been rendered almost uninhabitable by man, and are given over to drought and desolation.

A full abstract of the action of the Association committee on this important subject is worthy of being read, since its recommendations are highly judicious and sensible, and will be found in another part of this issue.

Growth and Comparative Magnitude of American Railways.

As a supplementary contribution to the statistics of American railways, given in our September issue, the following facts, from the same authority, will be found of interest. The following tabulation shows the growth of the American railway system from the period of its inception to the close of last year, namely:

Year.	*Miles in operation.*	*Year.*	*Miles in operation.*
1830	23	1871	60,283
1835	1,098	1872	66,171
1840	2,818	1873	70,278
1845	4,634	1874	72,383
1850	9,821	1875	74,090
1855	18,374	1876	76,808
1860	30,635	1877	79,147
1865	35,085	1878	81,841
1870	52,914	1879	86,121

The world's railways probably stands to-day as follows:

Europe	98,275	miles, or	47 per cent.
United States	86,121	"	41 "
Other countries	25,000	"	12 "
Total	**209,396**	**miles.**	

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

—o—

LUMBER.

Pine, very choice and extra dry, per M	$60 00 @ 70 00
Pine, good	55 00 @ 60 00
Pine, shipping box	20 00 @ 22 00
Pine, common box	17 00 @ 18 00
Pine, common box, ⅝	15 00 @ 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	42 @ 48
Pine, tally plank, 1¼, 2d quality	35 @ 38
Pine, tally plank, 1¼, culls	28 @ 30
Pine, tally boards, dressed, good	28 @ 30
Pine, tally boards, dressed, common	25 @ 28
Pine, tally boards, culls, dressed	22 @ 25
Pine, strip boards, merchantable	16 @ 18
Pine, strip boards, clear	22 @ 25
Pine, strip plank, dressed, clear	33 @ 35
Spruce boards, dressed	20 @ 22
Spruce plank, 1¼-inch, dressed	25 @ 28
Spruce plank, 2-inch	38 @ — 40
Spruce wall strips	14 @ — 15
Spruce timber, per M	20 00 @ 25 00
Hemlock boards, per M	16 00 @ 18 00
Hemlock joist, 2½x4, each	15 @ — 16
Hemlock joist, 3x4	16 @ — 18
Hemlock joist, 4x6	40 @ — 44
Ash, good, per M	50 00 @ — —
Oak	55 00 @ — —
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	45 00 @ 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black walnut, good to choice	85 00 @100 00
Black walnut, ⅝-inch	75 00 @ 85 00
Black walnut, selected and seasoned	110 00 @150 00
Black walnut counters, per ft	15 @ 20
Cherry, wide, per M	85 00 @100 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	30 00 @ 35 00
White wood, ⅝ panels	35 00 @ 40 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	1 65 @ — —
Yellow dressed pine flooring	30 00 @ 37 50
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, per inch	18 @ 20
Locust posts, 10 feet	24 @ 25
Locust posts, 12 feet	29 @ 34
Chestnut posts, per ft	3 @ 3½
Basswood per M	25 00 @ 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	2 75 @	3 25
Up Rivers	4 50 @	5 00
Jersey	— — @	— —
Long Island	— — @	— —
Haverstraw Bay	5 00 @	5 25
" " choice	5 50 @	5 75
Favorite Brands	6 00 @	6 50
Hollow Fire-Clay Brick	9 00 @	9 25

FRONTS.

Croton—Brown, per M.	10 00 @ 11 00
" Dark	11 00 @ 12 00
" Red	12 00 @ 13 00
Philadelphia	— — @ — —
Trenton	21 00 @ 22 00
Baltimore	38 00 @ — —
Clark's Ottawa White	25 00 @ — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia and Trenton, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	23 00 @ 23 50
" Glengarnock	22 50 @ 23 00
" Eglinton	20 00 @ 20 50
" American, No. 1	29 00 @ — —
" American, No. 2	22 00 @ — —
" American, forge	21 00 @ 22 00

Store prices. Cash.

Bar, Swedes, ordinary sizes	— 6 @ — 6¼
Bar, Swedes, nail-rod	— 6½ @ — —

LEAD—PER 100 POUNDS.

*German	— — @ — —
*English, common	— — @ — —
*Spanish	5 75 @ — —
*Foreign, refined	— — @ — —
*Bar	6 50 @ — —
*Sheet	7 50 @ — —
*Pipe	— — @ — —
*Domestic	4 63 @ — —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 00 @ 3 10
8d and 9d, common	3 25 @ 3 35
6d and 7d, common	3 50 @ 3 60
4d and 5d, common	3 75 @ 3 85
3d and 4d, light	4 50 @ 4 60
3d, fine	5 25 @ 5 35
2d, fine	5 25 @ 5 35
Cut spikes, all sizes	3 25 @ 3 35
Clinch nails, 1½ to 1¾ inch	5 25 @ 5 65
do. 2 to 2¼ inch	5 00 @ 5 35
do. 2½ to 2¾ inch	4 75 @ 4 85
do. 3 inch and longer	4 50 @ 4 60

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	6 75 @ 7 00
*I. C. coke, 10x14	5 50 @ 6 00
*I. X. charcoal, 10x14	8 75 @ 9 00
*I. C. charcoal, 14x20	6 75 @ 7 00
*I. X. charcoal, 14x20	8 75 @ 9 00
*I. C. coke, 14x20	5 50 @ 6 00
*I. C. coke, terne, 14x20	5 50 @ 5 75
*I. C. charcoal, terne, 14x20	6 00 @ 6 25

ZINC.—Duty, sheet per lb., 2½ cents.

Sheet, (cask) per lb	— 7⅝ @ — 7¾
Sheet, (open)	— 8 @ — 8½

SOLDER.

No. 1	— 12½ @ — 13
No. 2	— 11 @ — 12

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 @ 1 00
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown-Stone, Portland, Conn	1 30 @ 1 35
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Dorchester, N.B., Stone, rough, per foot	— — @ 1 00

PAINTS.

*Carmine, American, per lb. gold	6 00 @ 6 25
Chalk, per 100 lbs	— 35 @ — —
China Clay, per ton gold	18 00 @ 20 00
Chrome yellow, dry, per pound	— 12½ @ — 28
Lead, red American, per pound	— 6½ @ — 7
Lead, white American, pure, in oil	— 8½ @ — 9
Lead, white American, pure, dry	— 7¾ @ — 8¼
Lead, white English, pure, in oil gold	— 9½ @ — 10½
Litharge	— 6½ @ — 7
*Ochre, Fr., dry, per 100 lbs	1 50 @ — —
Ochre, ground, in oil, per lb	— 6 @ — 15
Ochre, Vermont, per 100 lbs	— 75 @ 1 00
*Orange Mineral, English gold	— 9½ @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, per lb	— — @ — 25
Putty, per lb	— 2½ @ — 3
Spanish Brown, dry, per lb	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, per lb	— 8 @ — 9
Venetian red, per cwt	1 75 @ 2 00
*Vermilion, Chinese, per lb	— 85 @ — 90
*Vermilion, Trieste	— 70 @ — 75
*Vermilion, quicksilver, bags gold	— 55 @ —57 ½
Vermilion, American, common	— 15 @ — 18
Whiting, per 100 lbs	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¼ @ — 9
Zinc, white French, in oil gold	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
do do	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

CEMENT—PER BARREL.

Portland (imported)	2 60 @ 2 85
Portland (American)	2 25 @ 2 50
Portland (Spanish)	2 50 @ 2 75
Portland (Lafarge)	3 20 @ 3 40
Portland (German, Bonner)	2 85 @ 3 25
Lime of Teil	2 20 @ 2 30
Lime of Teil, per ton	15 00 @ 18 00
Roman	2 75 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ — —
Rosendale	— 80 @ — 85

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb.	— 1¼ @ — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16 @ — 18
Goat, " "	— 21 @ — 25

SLATE.

Purple roofing slate, per square	$6 00 @ 6 50
Green slate	7 00 @ 7 50
Red slate	10 50 @ 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 @ 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 @ — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50 @ 4 00
Nova Scotia, blue	3 50 @ 3 75
Calcined, Eastern and city, per bbl	1 25 @ — —
Calcined, city casting	1 50 @ — —
Calcined, city superfine	1 75 @ — —

LIME—PER BARREL.

State, common	— 85 @ — —
" finishing	1 00 @ 1 10
Rockland, common, cargo rate	1 00 @ — —
" finishing	1 10 @ — —
Ground	— 95 @ 1 00

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 @ — 28
St. Domingo, crotches, fine	— 20 @ — 30
St. Domingo, logs, small	— 5 @ — 8
St. Domingo, logs, large	— 8½ @ — 14
Frontera, Mexican, large	— 9 @ — 12½
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ — 12½
Honduras	— 6 @ — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ @ — 4½
Rio Janeiro, good to fine	— 5 @ — 8
Bahia, ordinary to good	— 2½ @ — 4½
Bahia, good to fine	— 5 @ — 8
Honduras, per ton	10 00 @ 20 00
Satin Wood, per foot	— 15 @ — 25
Tulipwood, per lb	— 6 @ — 7
Lignumvitæ, large, per ton	25 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 20 00

CEDAR.

Cuba, per superficial foot	— 8 @ — 11
Mexican, small	— 8 @ — 9½
Mexican, large	— 10 @ — 11
Florida	— 40 @ — 75

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

REVIEW OF THE MARKETS.—In the lumber market the past month the local distribution has gathered volume to some extent, with promises of a still further increase. For building, manufacturing and box-making the daily sales have been very fair, and besides this many dealers have been furnishing assortments to small operators at suburban points, whose limited capital will not permit them to purchase entire cargoes, and especially so when the specification contains sizes unsuited to their particular line of trade. There has been quite enough stock to meet all calls, but the accumulation against future wants is moderate, and in some cases very small, with evidences of some anxiety among dealers to secure contracts. This is more particularly directed toward varieties likely to be first shut off by the closing of navigation, or such grades as may surely be calculated upon as scarce.

In the brick market the tone has continued cheerful and healthy, former rates have been obtained, and the demand has been full enough to exhaust supplies about as fast as they have come to hand. Dealers have as yet made no pretension to accumulate winter supplies, but when a good attractive cargo has been available they have been rather inclined to take it, and this, with the continuation of a comparatively full consumption, has kept the arrivals pretty much all in motion. As near as can be learned, there is no unanimity of action among the makers about the stoppage of production; but the colder condition of the weather and liability to frost is likely to settle this matter very soon, without the necessity for agreement.

In the lath market the tone has been strong. Sellers who have had anything to offer have found a great many customers looking for stock, and the anxiety to secure has been sufficient to keep bids on the upward turn. Receivers continue to report strong accounts from primary points, and are very confident that no reaction on values can take place during the balance of the season.

In the lime market about former rates have been obtained, with moderate supplies available of all kinds.

In the hardware market pretty much all the reports have been of a strong and cheerful character, and dealers have appeared well satisfied with the position. Recent buyers have handled larger amounts than anticipated, and local wants have been large and general. On prices the average tone has been firm, and manufacturers generally claim to be able to resist any downward turn.

In the paint market a pretty good general business has been doing in paints and colors, and there are evidences of a steady increase in the volume of trade for some little time to come. This has naturally given matters a cheerful tone, and dealers as a consequence have been in good spirits.

In the metal markets manufactured iron has been fairly active on orders from regular customers, with prices on most shapes about steady. American pig has found some little demand, but the wants of buyers have not been anxious, and have rarely extended beyond some special early requirements. Scotch pig has shown quite an irregular tone, but the general tendency has been in buyers favor and growing evidences of a desire to realize on the part of several holders. Domestic pig lead has met with a somewhat irregular demand, but business reached a fair aggregate and prices have been pretty well supported. Pig tin has been irregular, according to the influence of foreign advices, but as a general thing holders have refrained from any special effort to realize, and the expectations have been based mostly upon higher prices. Tin plates have met with a more liberal sale since our last report, but buyers have been about all supplied, and the tone at this writing is easier. Zinc has been in good average demand, with prices steady.

THE DEEPEST PERPENDICULAR SHAFT in existence is the Adelbert shaft in a silver-lead mine in Przibram, Bohemia, which is 3,280 feet deep. Twenty years ago a mine in Hanover reached a depth of 2,900 feet, while there are numerous shafts that reach 2,000 feet.

Home Department.

Nothing Remains at Rest.

It is a fallacy to suppose that there is any such thing as rest to matter. There is not a particle in the universe which is not on the move, not a drop of fluid on the globe that is perfectly quiescent, not a fiber in the vegetable kingdom in a state of inactivity. In animal bodies, from monads to the complicated organism of man, every part and parcel, even in the solids, are incessantly moving among themselves, and their component elements never cease to act in accordance with that universal law till death stops the machinery. Even then a new series of movements commences at that culminating point. Chemical dissolution of organic structures is but a liberation of molecules, the aggregation of which was necessary for a corporeal beginning and subsequent growth; and then they dispersed to enter into new relations and new forms, and thus one never-ending circle of activity characterizes the material universe.

Death is a dissolution of the union that existed for a limited period of what is called life with organized matter. How that union commenced is as much a mystery as their separation. They are distinct in nature and character, although one cannot manifest itself without the brain and nerves of the other.

Astronomy reveals the astounding intelligence that there are no fixed or stationary bodies in the unsurveyed regions of celestial space. Even the fixed stars, as they were once considered, permanent landmarks in the heavens, are coursing with undefined rapidity in the train of countless globes of shining glory, on a circuit too distant to be followed even by human imagination, in the boundless realms of space.

Everything, therefore, is moving. When motion ceases there will be a wreck of worlds and a crash of an entire universe. Life is motion; inertia, to our finite minds, is death. Nature, however, neither modifies nor repeals a law, and consequently, those now in force will operate with unerring certainty through the endless cycles of eternity.

Talk Over what You Read.

The subject of home reading has been under discussion in the *Christian Union*. A correspondent makes an excellent suggestion: "After reading all that has appeared in your columns, either editorially or from correspondents, allow me to add one hint that I do not think has been given, the immense advantage of talking about what has been read. Nearly forty years' experience as a teacher has shown me how little I truly know of a subject until I begin to explain it or teach it. Let any young person try the experiment of giving in conversation, briefly and connectedly, and in the simplest language, the chief points of any book or article he has read, and he will see at once what I mean. The gaps that are likely to appear in the knowledge that he thought was his own, will, no doubt, appear surprising. I know of no training superior to this in utilizing one's reading to strengthen the memory, and in forming habits of clear and connected statement. It will doubtless teach other things than those I have mentioned, which the person who honestly makes the experiment will find out for himself. Children who can read can be encouraged to give, in a familiar way, the interesting parts of books they have read, with advantage to all concerned. More than one youth I know has laid the foundation of intellectual taste in a New England family where hearty encouragement was given to children and adults in their attempts to sketch the lectures they had heard the evening previous. The same thing was done with books."

Wealth.—Wealth is potent in its own sphere, but unimportant beyond it. It can put a telegraph under the sea and cover the land with a net-work of wires as with a spider's web. It can build railroads and bridge oceans. It can buy houses and lands, and every material advantage; but here its power stops. It cannot purchase goodness, or justice, or gentleness, or patience, or love, or true friendship. It cannot do anything to make the character stronger or life sweeter. It can say to the minister, I feed you and clothe you while you are making men wiser; but it can do nothing without the brains of wisdom or the heart of goodness. It can build railroads, but it cannot build men.

Rogers' Groups.

No commendation from our pen is needful to testify to the artistic merits that have made Rogers' groups familiar to persons of taste and refinement throughout the length and breadth of the land. Mr. Rogers has the inspiration of genius in the selection of his subjects and the artistic skill in treating them in the most effective manner. The subject of which we here present an illustration, is the latest gem that has issued from his hands.

It represents the great trial scene in Shakespeare's "Merchant of Venice," representing Portia, Antonio, Bassanio and Shylock. The Jew is demanding the

Rogers' Latest Group.

"pound of flesh"—the forfeit that Antonio has agreed to pay as the penalty for non-payment of borrowed money; the disguised Portia is urging Shylock to have a surgeon at hand to check the flow of blood, and Shylock is in the act of exclaiming, "Is it so nominated in the bond?" The grouping and expression of the actors are simply admirable.

The price of these gems of art is so moderate as to place them within the reach of all, which is not the least of their merits. Catalogues giving illustrations of these groups may be had on application, or will be mailed to any address by enclosing ten cents to John Rogers, 23 Union Square, New York.

How Diseases are Propagated.—The assertion is made by Prof. Tyndall that diseases are propagated, not by effluvia or sewer gas, but by solid particles discharged into the atmosphere by currents of air or gas. This conclusion he was led to by the following experiment: He cut up a piece of steak steeped in water, heated it at a little above the temperature of the blood, then strained off the liquid; in a short time this fluid became turbid, and when examined through the microscope was found to be swarming with living organisms. By the application of heat these were killed, and when the solution was filtered, he obtained a perfectly pure liquid, which, if kept free from particles of dust, would remain pure for an unlimited period; but if a fly were to dip its leg in fluid containing living organisms, and then into the pure liquid, the whole would be swarming with animalcules in 48 hours.

Sanitary Matters at Princeton College.

In our last issue we commented on the utterances of the President of Princeton college at the late commencement, in reference to the recent outbreak of a typhoid epidemic among the students of this institution, in consequence of defective drainage. We give below an abstract of certain newspaper accounts that have been published within the past month, and which most probably have originated with, or have been inspired by, the college authorities, with the object of placing themselves right before the public, by narrating in detail what they have done to restore the college building to a healthful condition. We are quite willing to give the college authorities the benefit of a full statement of their sensible efforts to put their house in order, for our only purpose in reviewing the president's address was to place the stamp of our contempt upon the hypocritical pretence which he framed in words, that Providence, and not the college authorities, was responsible for the calamity that closed the doors of the institution and sent half a score of amiable and promising young men to untimely graves.

We regard it as a piece of great good fortune for the reputation of Princeton College, and especially so for the welfare of its students, that there were clear-headed, sensible men among those in authority, who estimated the stereotyped Pharisaism of Dr. McCosh at its true value. We leave our readers to judge for themselves how completely the subsequent action of the college authorities, as narrated below, shows this man to have stultified himself:

"In May last the faculty and trustees of the College of New Jersey, at Princeton, found it necessary to close the doors of the institution and send all the hundreds of students away, on account of the breaking out of what at that time seemed to be a mysterious and very malignant disease. This was just at the most interesting and important period of the collegiate year, when all the members of the senior class were preparing for their final examination. The first student who fell a victim to the strange malady, had been boarding at the Runyon House. A few days after he was taken home the same disease broke out in the college, and thirty students were attacked. About one-third of them died. On examination by competent medical men it was ascertained that the disease was typhoid fever. At the same time, an examination of the well at the Runyon House showed that there was foul water, and it was concluded that the student who lived at the Runyon House had contracted the disease from drinking the water, and that the others had caught the disease from him. After finding that the disease was undoubtedly endemic, but spreading in the college, a meeting of the trustees was called. It was resolved to close the college at once. From that day until this the college doors have been opened to students and the public only once, and that was one day in June, when the annual commencement exercises were held. During all this time the faculty and trustees have by no means been idle. The first thing they did was to appoint a new curator of the college buildings and grounds. Next they appointed a sanitary commission, consisting of Professor E. G. Janeway, of the New York Board of Health, Dr. E. M. Hunt, a leading New Jersey physician, and Edward S. Philbrick, of Boston, who has won a reputation in that city as a sanitary engineer. These men were instructed by the trustees to make a thorough examination of the college buildings, as well as of the hotel and principal boarding-houses, and to report what should be done, not only to disinfect those buildings, but to prevent disease, as far as possible, in the future.

"Dr. Janeway and Dr. Hunt, after making several inspections of the buildings, made up their minds as to what should be done to make the college and its surroundings healthful. To Mr. Philbrick was left the task of deciding how to do it. But it seems that the trustees, counseled and aided by the members of the faculty, have done a great deal more than the commission recommended. For example, where the

commission recommended the cleaning and disinfecting of a cesspool that connected with the college buildings, and to which the disease was in part traced, the cesspool has been filled up. Where the commission discovered a chance for the escape of sewer gas, and recommended a remedy, the sewer pipes have been taken up and abandoned. In fact, so eager were the professors and trustees to make the surroundings of the institution perfectly healthful, that they determined to make all sewerage within the walls of the buildings absolutely unnecessary. The result is that the college buildings are now entirely devoid of sewage drains. The sewage pipes now have their beginning in a building entirely separate from the college, and their termination will be far away from the college grounds, and far beneath the ground. This plan is the one known as subsoil irrigation, and has been adopted in many European cities. It is thought to be perfectly safe. All the noxious gases are absorbed by the earth, and the sewage is carried off by deep drains.

"In the work of thoroughly renovating the college buildings, many thousand dollars were expended—at least twice as much as the changes recommended by the sanitary commission would have required."

The Fair of the American Institute.

The forty-ninth annual fair of the American Institute opened September 15th, and is one of the largest, most complete, and most interesting yet given by this organized representation of American industry. So numerous were the applications for space, that the managers were under the necessity of rejecting about one-third, it being impossible to admit all. This has afforded an opportunity to discriminate severely in favor of the most worthy.

The class of exhibits is of a higher grade than last year, and we notice many novelties which we shall take occasion to review in our next issue. The motive power is furnished by Robert Whitehill, of Newburgh, N. Y., and Jerome S. Wheelock, of Worcester, Mass.

The managers, to enable exhibitors of steam machinery to display their inventions to the best advantage, have made arrangements with the Carvalho Heating and Superheating Company for the erection of an improved apparatus, superheating by hot water circulation under pressure, whereby all the steam generated in three sets of boilers will receive at least 100 degrees additional heat.

Petroleum vs. Steam.

To the Editor of the Manufacturer and Builder:

Some weeks ago there arrived at this port a government launch on the U. S. S. "Tallapoosa," which boat was afterward towed to Exeter by the "La Chiquita." This launch was furnished by the navy department at Washington to the Exeter Machine Works for experimental purposes, and has been fitted with a novel motive power, said power consisting of what is known as the Brayton petroleum engine, the motive power of which consists of a gas cylinder and air pump, placed longitudinally side by side, and connected to the same crank shaft. The power is originated by the combustion of petroleum oil in the gas cylinder, which is supplied with compressed air from a receiver, in which it is kept at the desired pressure through the agency of the air pump, the speed of the engine being increased or diminished by graduating the quantity of air introduced into the gas cylinder from the air tank. The engine makes about 300 revolutions a minute, and the main (or gas) cylinder is kept cool by water which circulates up through one piston rod and piston head, passing out through the other piston rod. On the shaft is a large spur wheel which gears on to the wheel that drives the propeller. The connection with the propeller shaft is one of the most ingenious features of the invention; the engine always moves in the same direction, whether the boat is going ahead or backing, the motion of the screw being governed by two cogwheels, one of which it drives forward and the other backward; these are controlled by friction clutches, which are operated by air pressure from the tank. The propeller is under the direct control of the pilot, who governs its direction by means of a small lever located close to the wheel, so that the going ahead, easing and reversing are entirely independent of the engineer. The motive power is obtained from petroleum, contained in a small tank forward, which is fed to the engine automatically as required. The machinery is almost entirely below the water-line, which adds to the steadiness of the vessel, and is entirely concealed from view. C. R. S.

Portsmouth, N. H., September 25th, 188.

Emerson's Saw Book.

The latest evidence of the enterprise and prosperity of Emerson, Smith & Co., of Beaver Falls, Pa., the well-known saw manufacturers, comes to us in the form of a handsomely gotten up reference book, containing, in addition to description and price-lists of their various manufactures, much information of value to the users of saws. We glean from the opening page of this handbook that the saws of this firm were successful in the great national sawing contest, occupying three days, which took place at the Cincinnati Exposition, at which the firm was awarded the silver medal for the best saw, and the gold premium of $100 for the best sawing. The firm refer likewise to similar evidences of the excellence of their manufactures obtained in the great International Exhibition at Philadelphia. We are pleased to note the evident prosperity of these enterprising manufacturers, and congratulate them on their success.

Miscellaneous and Advertising.

The Chinese workmen introduced by the manufacturers of North Adams, Mass., are leaving the place, many of them returning to China.

The George Place Machinery Agency, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

The Tanite Co., of Stroudsburg, Pa., always aiming to keep the lead, are continually making improvements in their celebrated Tanite wheels and grinding machines, and have been obliged to increase their facilities of manufacture largely of late by reason of the greatly increased demand for their goods.

All buildings should be provided with Austin's patent expanding conductors, the corrugated form of which allows of contraction and expansion, and thus prevents any opportunity for bursting or leakage. The sole manufacturers of this admirable pipe are Austin, Obdyke & Co., 1705 and 1725 Chestnut street Philadelphia.

The Geo. F. Blake Manufacturing Co., of New York and Boston, are engaged in building a duplex pumping engine, of a daily capacity of 2,500,000 gallons, for the city of Lacrosse, Wis. They have also under contract a pair of pumping engines with a combined capacity of 1,500,000 gallons daily, for the new water-works now being built at Stillwater, Minn.

The population of all the States in the Union, as compiled by the New York *Herald*, amounts to 49,302,144. The population of six of the territories, given at 563,998, swells the total to 49,865,142. The population of the four remaining territories will undoubtedly bring the grand total up to 50,000,000. This is an increase of 11,700,000 during the past ten years—something over 30 per cent.

Mr. Jesse W. Starr, Jr., of Philadelphia, has just closed a contract with the authorities of Joliet, Ill., for complete water works for that town. He will use two of Knowles' compound condensing pumping engines, having a capacity of three million gallons per day. They will be similar in design to the pumping engines built by the Knowles Steam Pump Works for the Charleston (S. C.) water works, which proved so satisfactory to Mr. Starr, who has just completed his contract for those works.

The attention of our readers is invited to the patent packing manufactured by Jenkins Brothers, of 104 Sudbury street, Boston, and which for the period of twelve years during which it has been manufactured, has given universal satisfaction, as is demonstrated by the testimony of the best mechanics and engineers throughout the country. This packing is composed of refractory materials, especially selected on account of their heat-resisting qualities and for their adaptability to withstand the action of oils, acids or other solvents, for which reason it is equally well adapted for joints of all kinds, whether for steam, gas or water; and its composition being such that it will pack a rough as well as a finished joint. This packing is made in many forms and for many uses, such as disks for valves, packings for valve stems, gaskets, union rings, steam pump valves, washers for hot and cold water faucets, etc. The manufacturers have lately taken the opportunity of cautioning the public against imitators and infringers of their patents (of which they hold several relating to this class of packing), as they are about instituting suits against certain infringers. The genuine packing can be obtained from all the leading dealers in machinists' supplies.

Design for a Cheap Cottage.

We present, in the design on the opposite page, the most desirable results that can be achieved from so limited an outlay. The cost of this cottage, under judicious management, will not exceed $1,800, and in skillful hands and under favorable conditions, the cost could be easily reduced to a still lower figure. It was originally prepared, some years ago, for one of those charming sites in the vicinity of Nyack-on-the-Hudson, since which time it has been so frequently and successfully adopted that we think its publication will be gratifying to many of our patrons.

In the arrangement of the interior and treatment of the exterior, it has been the effort of the architect to secure commodiousness and beauty by the most simple and economical means. The dimensions of the building are shown by the figures on the first-floor plan. The letters on the plans indicate as follows:

First Floor.—A, portico; B, hall; C, parlor; D, dining-room; E, kitchen; F, pantry; G, lobby; H, rear portico; I, cellar stairway.

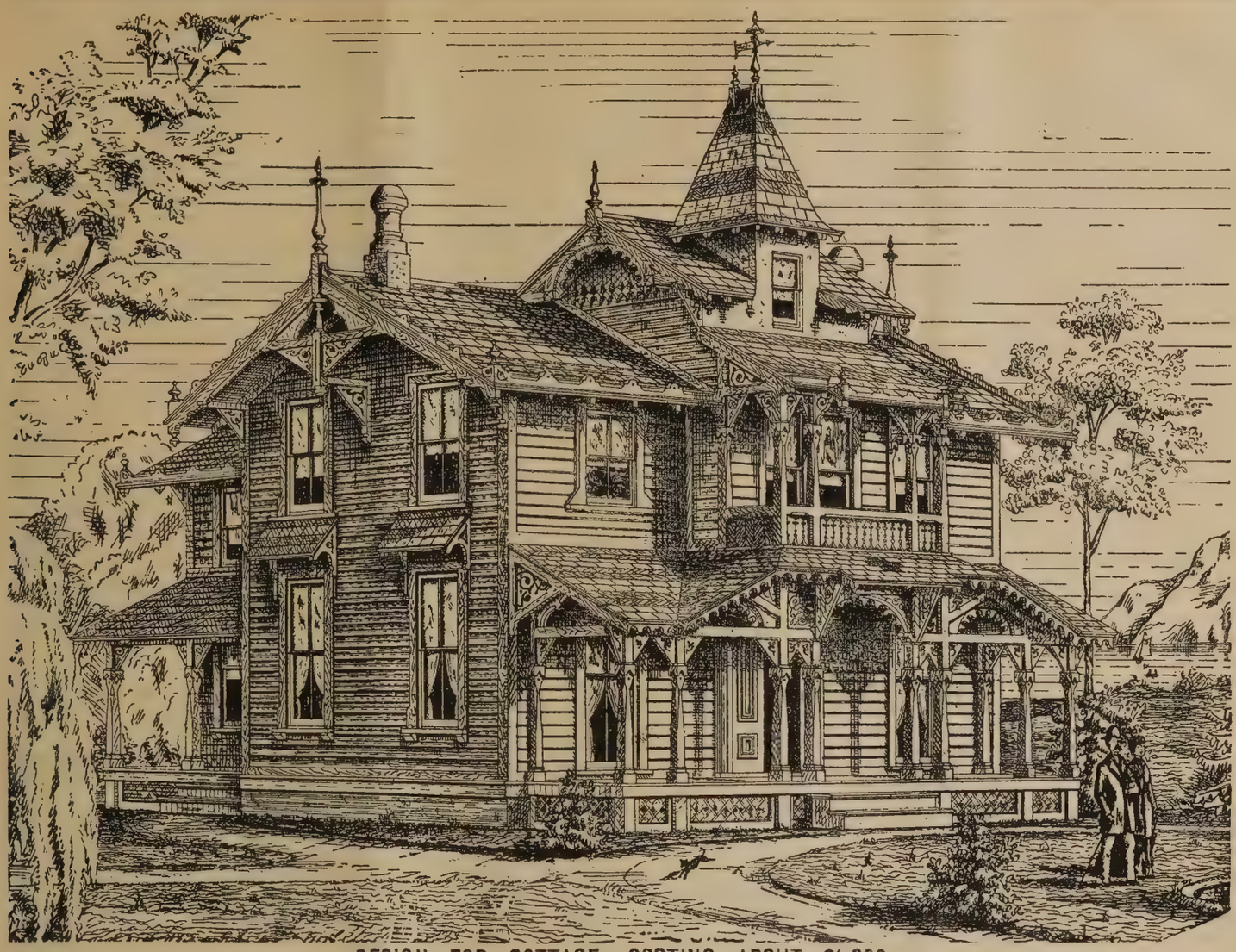
Second Floor.—J, platform; K, L, M, N, chambers; O, dressing-room; P, closets; Q, balcony.

It will be noticed that every room is of good size, well lighted, and capable of thorough ventilation. The parlor and dining-room communicate with the front portico by long windows, and the folding doors dividing these rooms from the hallway, give, when thrown open, a decidedly spacious effect to this floor. The kitchen is admirably located for excluding the annoyances of its odors, heat or noise from the main part of the house, and at the same time it is conveniently accessible. A spacious pantry divides it from the dining-room, and a small lobby communicates it with the cellar stairway, main hall and rear portico. A cellar is excavated under the main portion of the building only. The chimneys of this part are supported, some distance above the first floor, on handsome trusses.

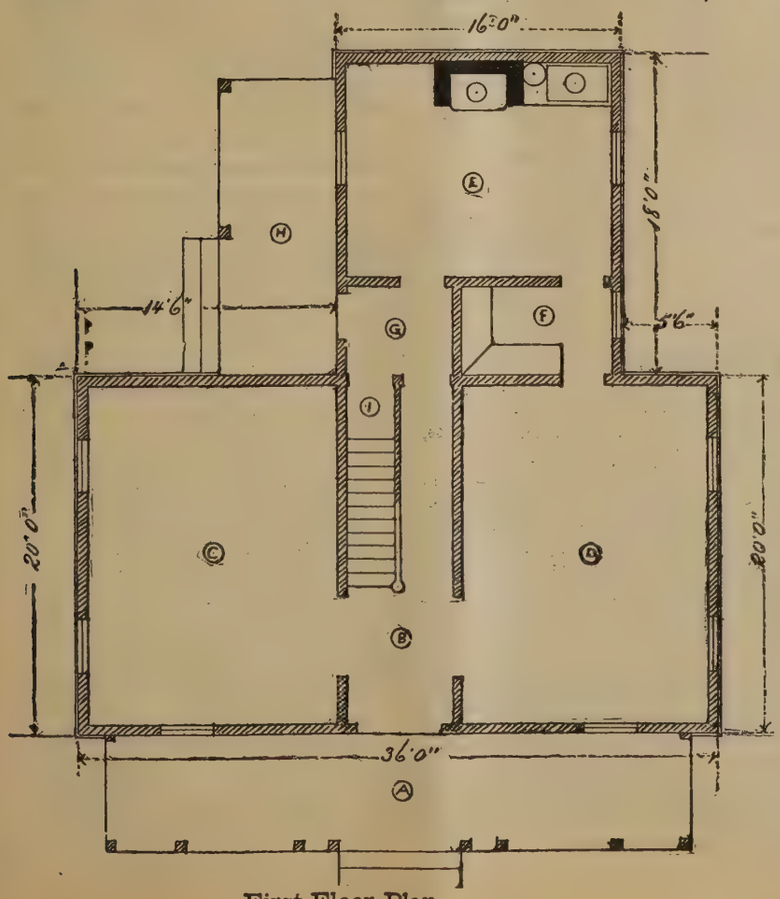
The second floor explains itself at a glance. All the rooms are directly accessible, and of good size. A storage attic is reached by a step-ladder stairway.

The construction of this cottage is exceedingly simple, but substantial and effective. The frame is sheathed with felt and novelty siding, and the roof is shingled. The external details admit of a free display of colors, and a little effort on the part of an artistic painter will render the cottage exceedingly attractive.

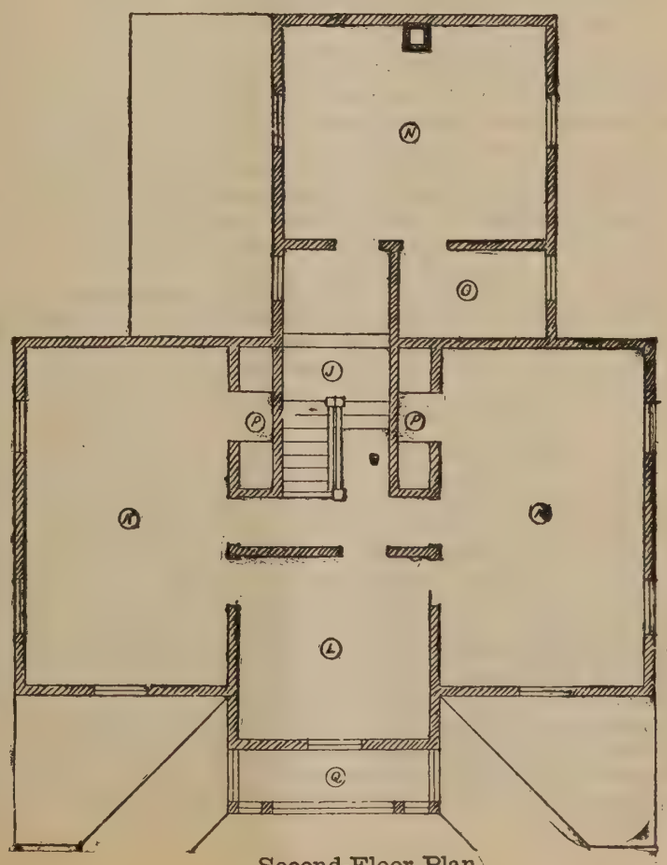
The architect is Mr. Horace G. Knapp, of Nyack, N. Y.



DESIGN FOR COTTAGE, COSTING ABOUT $1,800.



First-Floor Plan.



Second-Floor Plan.

Cements for the Shop.

Iron Cement for Closing the Joints of Iron Pipes.—Take of coarsely powdered iron borings, 5 pounds; powdered sal-ammoniac, 2 ounces; sulphur, 1 ounce; and water sufficient to moisten it. This composition hardens rapidly; but if time can be allowed, it sets more firmly without the sulphur. It must be used as soon as mixed, and rammed tightly into the joint.

2. Take sal-ammoniac, 2 ounces; sublimated sulphur, 1 ounce; cast-iron filings or fine turnings, 1 pound; mix in a mortar and keep the powder dry. When it is to be used, mix it with 20 times its weight of clean iron turnings or filings, and grind the whole in a mortar; then wet it with water until it becomes of convenient consistency, when it is to be applied to the joint. After a time it becomes as hard and strong as any part of the metal.

Cement for Uniting Leather and Metal.—Wash the metal with hot gelatine; steep the leather in an infusion of nutgalls (hot) and bring the two together.

Cement for Leather Belting.—One who has tried everything, says that after an experience of fifteen years he has found nothing to equal the following: Common glue and isinglass, equal parts, soaked for ten hours in just enough water to cover them. Bring gradually to a boiling heat, and add pure tannin until the whole becomes ropy, or appears like the white of an egg. Buff off the surfaces to be joined, apply this cement warm, and clamp firmly.

Steam Boiler Cement.—Mix two parts of finely powdered litharge with one part of very fine sand, and one part of quicklime which has been allowed to slake spontaneously by exposure to the air. This mixture may be kept for any length of time without injuring. In using it, a portion is mixed into paste with linseed oil; or, still better, boiled linseed oil. In this state it must be quickly applied, as it soon becomes hard.

Turner Cement.—Melt one pound of rosin in a pan over the fire, and when melted, add one quarter of a pound of pitch. While these are boiling, add brick-dust until by dropping a little on a cold stone, you think it hard enough. In winter it may be necessary to add a little tallow. By means of this cement a piece of wood may be fastened to the chuck, which will hold when cool; and when the work is finished, it may be removed by a smart stroke with the tool. Any traces of the cement may be removed from the work by means of benzine.

Wollaston's White Cement for Large Objects.—Beeswax, 1 ounce; rosin, 4 ounces; powdered plaster of Paris, 5 ounces. Melt together. To use, warm the edges of the specimen, and apply the cement warm.

Gutta-Percha Cement.—This highly recommended cement is made by melting together, in an iron pan, two parts of common pitch and one of gutta-percha, stirring them well together until thoroughly incorporated, and then pouring the liquid into cold water. When cold, it is black, solid and elastic; but it softens with heat, and at 100° Fah. is a thin fluid. It may be used as a soft paste, or in the liquid state, and answers an excellent purpose in cementing metal, glass, porcelain, ivory, etc. It may be used instead of putty in glazing windows.

Newspapers in America.

H. P. Hubbard's "Newspaper Directory of the World," published by him in New Haven, Conn., gives the following figures respecting American newspapers: There are 10,131 American (United States and Canada) newspapers—899 dailies, 8,428 weeklies, tri-weeklies and semi-weeklies, 804 monthlies and semi-monthlies. The total circulation of a single issue of each of these papers (omitting 1,920 not given) reaches the enormous aggregate of 20,677,538 copies, divided as follows: Dailies, 3,540,156; weeklies, tri-weeklies and semi-weeklies, 13,511,425; monthlies and semi-monthlies, 5,625,958. This is an average of 2,041 to each paper for a single issue, and taking all issues of the whole for one year, a grand total of 1,836,473,592 copies. Taking ordinary 40-pound news paper at its average measure of 4,000 sheets (solid) to the foot, one issue of all these piled up would measure 5,170 feet (nearly a mile) in hight, or for a whole year, 459,119 feet (over 87 miles) high. Counting them all at the average size of 27 × 41 inches, and placed end to end, one issue would extend 70,648,255 feet (13,380 miles); for one year, 6,274,618,106 feet (1,888,374 miles), or over 47 times around the earth, and five times the distance from the earth to the moon. In a thousand ems of type there are over 2,000 different pieces, and in an average four-page eight-column paper, set in solid brevier type, there are 140,000 ems (about 450 pounds), or 296,000 types in one newspaper. To print one issue of the total 10,131 papers of this average size, there must be handled nearly 5,000,000 pounds of type, or 2,998,776,000 types. The total number of editions of all these dailies, weeklies and monthlies for one year, would make 724,796, and to print them necessitates the handling of 2,173,499,849,626,000 types. These averages are minimum rather than maximum. There is usually twice as much type, at least, in an office as will set the paper, consequently, for this purpose alone, there must be 10,000,000 pounds in use, the value of which is about $5,000,000.

Population of Cities in 1880 and 1870.

In the following we give the present population of the leading American cities, as compared with the census of 1870:

Cities.	*1880.*	*1870.*
New York	1,208,471	942,252
Philadelphia	843,000	674,022
Brooklyn	554,693	395,099
Chicago	502,940	298,977
St. Louis	395,000	310,864
Boston	352,345	250,526
Baltimore	350,000	267,354
San Francisco	280,000	219,473
Cincinnati	246,153	216,239
New Orleans	215,239	191,418
Washington	160,000	109,204
Cleveland	156,946	92,829
Newark	136,983	105,059
Milwaukee	130,000	71,440
Detroit	119,000	79,577
Louisville	112,000	100,753
Jersey City	105,000	81,744
Providence	104,500	68,904

Reputed Gold Discoveries in New York.—The daily papers of recent date contain accounts of alleged gold discoveries in the State of New York, the discoveries in question being located in the counties of Hamilton, Fulton and Saratoga, on the southern edge of the Adirondack wilderness. Quite a number of claims have been filed, and considerable excitement has been aroused.

New Publications.

After Dogmatic Theology, What? Materialism, or a Spiritual Philosophy and Natural Religion. By Giles B. Stebbins, Detroit, Mich. Boston: Colby & Rich. 1880.

It must be admitted, whatever value one may place on his conclusions, that Mr. Stebbins has written a very interesting, readable book. He starts out with a strong chapter on the decline of dogmatic theology, calling to his aid, in proving his thesis, such lights of the Church as Matthew Arnold, Dean Stanley, Rev. Phillip Brooks, and others equally eminent.

This much proven, the author asks, "What shall come in place of dogmatic theology? What ideals and inspirations shall help us when these 'old things' have passed away? Plainly enough, the day of dogmatic theology is passing away. Let us rejoice at that. What next? is the important question. What ideas of life and destiny and deity shall give hue and shape to the thought of coming time? As we pass out from the realm of a decaying dogmatism, two paths open before us. One leads to Materialism—the potency of matter; mind and soul, but fine and transient results of the chemistry of digestion; the negation of personal immortality and of a Supreme Intelligence. The other leads to Spiritualism—using the word in a broad sense—the potency *in* matter, guided and governed by the in-dwelling Soul of Things; man, 'an intelligence served by bodily organs,' a spirit clad in flesh, catching glimpses of the life beyond. These differ and diverge widely; they are, indeed, opposite to each other. Their differing ideals and methods may act as mutual corrective and counterpoise, and as stimulus to inquiry and criticism; yet that which is most true, must and will bear sway at last, and must be in accord with man's best development and finest culture. Let us look at both, and seek answers to these pressing and vital questions by fair statement and criticism."

Briefly condensed, the question sought to be answered by the author, is whether a spiritual philosophy or a material philosophy is to rule the world, and he concludes in favor of the former.

Hand-Book of Land and Marine Engines; including the Modeling, Construction, Running and Management of Land and Marine Engines and Boilers. With illustrations. By Stephen Roper, Engineer. Fourth edition. 12mo, tucks, gilt edge. Price, $3.50. Philadelphia: E. Claxton & Co. 1880.

Use and Abuse of the Steam Boiler. By Stephen Roper, Engineer. With illustrations. 18mo, tucks, gilt edges. Price, $2. Philadelphia: E. Claxton & Co.

We had occasion, in noticing last month the "Engineer's Handy Book" by this author, to comment favorably on the general character of the books with which his name is associated. The two books above named are excellent examples of the thoroughly practical character of Mr. Roper's books for engineers. The "Hand-Book of Land and Marine Engines" has reached its fourth edition, and both volumes are widely and favorably known among the class of readers for whom they have been specially prepared, namely, the practical engineer. Both books are distinguished throughout by their plain and readily comprehensible exposition of the topics they treat of, and by the absence of mathematical technicalities that can only serve to confuse the majority of men in charge of boilers and engines, instead of aiding them in clearing up the difficulties that arise in their every-day experience. Both books are provided with good indices, and the topics presented are paragraphed and distinguished by a prominent black-letter heading, thus making the work of reference easy—a decided merit which readers will appreciate.

Second Geological Survey of Pennsylvania. Report of Progress P P. The Permian or Upper Carboniferous Flora of West Virginia and Southwest Pennsylvania. By William M. Fontaine and I. C. White. With thirty-eight plates. Harrisburg: State Print. 1880. Pp. 144, 8vo.

The authors of this volume have made the interesting discovery that the so-called "Upper Barren" coal measures of Pennsylvania and Virginia are of permian age—a fact which they demonstrate with reasonable certainty by the study of its plants. The argument they advance is based on the examination of 107 species, of which 22 occur in the coal measures proper, while 28 (including 16 of the preceding) are European permian species; and of these 28, 12 have never been found in the coal measures proper of the United States, and 2 are exclusively permian. The report is undoubtedly a valuable contribution to science, since the recognition of the proper horizon of these beds affords a more certain means of deciding the exact period of the "Great Appalachian Revolution," and of explaining other interesting geological facts bearing on the presence or absence of beds of certain ages on the eastern portion of the North American continent.

The volume is handsomely gotten up, the plates being admirably printed on tinted paper, and forms a companion volume to the previously published volume P, entitled "Coal Flora Atlas."

OTHER PUBLICATIONS RECEIVED.

American Chemical Journal, Vol. II., Nos. 2 and 3. From the editor.

Journal of the Cincinnati Society of Natural History, Vol. III., No. 2, July, 1880. From the Society.

Annual Report of the Board of Directors of the Chicago Astronomical Society. Chicago. 1880. From the Society.

Tea Culture as a Probable American Industry; and other pamphlets from the U. S. Department of Agriculture, Washington, D. C.

First Annual Report of the Department of Statistics and Geology of the State of Indiana, 1879. Indianapolis. 1880. From Prof. John Collett, Chief of the Bureau.

Preliminary Report in regard to the Foreign Commerce of the United States during the year ended June 30th, 1880. Washington, D. C., Treasury Department, Bureau of Statistics.

Eleventh Annual Report of the United States Geological and Geographical Survey of the Territories, embracing Idaho and Wyoming; being a Report of Progress of the Exploration for the Year 1877. By F. V. Hayden, U. S. Geologist. Washington: Government Print. 1879. From the Secretary of the Interior.

Quarterly Report of the Chief of the Bureau of Statistics, Treasury Department, relative to the Imports, Exports, Immigration and Navigation of the United States, for the three months ended March 31, 1880. Also containing other statistics relative to the trade and industry of the country. Washington: Government Printing Office. 1880.

Summary Statement of the Imports and Exports of the United States for the month ended June 30th, 1880, and for the twelve months ended the same, compared with the corresponding periods of 1879. Also a statement of imported merchandise remaining in warehouse June 30, 1880 and 1879, respectively. Prepared and published by the United States Bureau of Statistics. [Corrected to August 23, 1880.]

Correspondence.

COOPER'S MECHANICAL MOVEMENT.

To the Editor of the Manufacturer and Builder:

In your issue for July, 1880, I notice a description, with illustrations, of "A Novel Mechanical Movement," patented by John H. Cooper, Superintendent of the Peoples' Works, Philadelphia. As this movement is in use nearly as general as bevel and spur gearing—inside and outside—in loom building, it would be interesting to know how old Mr. Cooper's patent is, if he claims to be the inventor of it, or if his patent is only on the application of it. As the same movement is used also in watches, under the name "Geneva stop," it would also be interesting to know whose invention that is—if it is Mr. Cooper's. I for my part have no interest in it, except to find out who is the original inventor, as I have seen it so much in use and never knew or heard it was protected by a patent, but always supposed it to be free for anybody to use having need of such a movement.

I, and I think many of your readers, would be very much obliged to you for more information about it, through the columns of your valuable journal. I am, etc., M. E.

ANSWER.

Replying to M. E., we desire to say that Mr. Cooper's patent is dated Oct. 3d, 1871, and the fact that a patent with certain specific claims has been issued to Mr. Cooper, is *prima facia* evidence, in the absence of good evidence to the contrary, that his invention is original. M. E. is doubtless aware of the fact that a principle in mechanics cannot be patented, nor the application of a thing apart from the thing.

We are not familiar with the precise movements in looms, to which M. E. refers as anticipating Mr. Cooper's invention; but if he will favor us with drawings or references for comparison, we will be under obligations to him. With respect to the "Geneva stop," which M. E. also refers to as anticipating Mr. Cooper's invention, we fail to see any essential point of identity. Mr. Cooper does not patent the principle involved in an intermittent movement, which is had in a hundred ways; but a combination of parts which will move without jar, stop and stand with precision, in which the driver revolves uniformly, and all parts may be adjusted to wear and be easily renewed. A "Geneva stop" is made to positively stop the revolving part after it has made a few revolutions, and needs no precision of workmanship to effect this object, merely two metal disks, the revolving one with one tooth, and the intermittent one with a few notches in part of its periphery. The intermittent movement is not necessary to its action at all, as the same effect may be produced by a rack and pinion, with a few teeth in the rack, requiring the teeth to stop at either end for want of tooth spaces. Cooper's movement, on the other hand, was designed to have a momentary stop, and a quiet advance, continuously produced and alternated. Cooper's movement continues; the Geneva stop allows of three or four turns, and there ends unless reversed.

We should be pleased to hear the arguments of M. E. upon this and the preceding point, accompanied by such information and drawings bearing on the subject as he may have, as we are interested in the subject, and feel sure that Mr. Cooper will be equally interested.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2689) Chian Turpentine.—What is Chian turpentine that is of late much talked of as a successful remedy for cancer? What do you think of it?—A. T., St. Johns, N. B.

(2690) Removing Silver from Plated Ware.—Please inform me how to take the plating off of old silver-plated ware, and get the silver out.—C. H. H., Augusta, Me.

(2691) Illumination by Coal Gas.—Please state in your answers to correspondents who first introduced lighting by coal gas—A. J. P., Pittsburg, Pa.

(2692) Lead and Mercury Poisoning.—I have seen several references in my reading of a very successful plan of treating lead and mercurial poisoning, discovered by Melsen, or Milsens. Can you state what his plan is, or refer me to an account of it? and oblige.—W. R. S., Indianapolis, Ind.

(2693) Weight and Volume of Different Substances.—Will you favor a constant reader with a table showing the weight of a cubic foot of such materials and substances as are commonly used in mechanical and architectural construction; and showing also the number of cubic feet of each contained in a ton. I would find such a memorandum very useful.—S. R. J., Akron, O.

(2694) Weights of Casting and Pattern.—Can you refer me to any tables, giving, near enough for practical purposes, the weight of a casting in various metals, from that of the pattern?—M. B. F., Valley Forge, Pa.

(2695) Number of Bricks in Walls and Massive Work.—I would be obliged to you if you can give me an idea of the number of bricks of usual dimensions, in say a square foot of wall of different thicknesses, and also in solid work.—J. H. McC., Watertown, N. Y.

(2696) Artificial Gems.—What is the composition of the so-called paste of which imitations of the diamond and other precious stones are made in France? What are the formulæ used for imitating the leading gems?—B. E. W., Rochester, N. Y.

(2697) Type Founding in America.—I would like to be informed through the columns of your useful journal, when, where, and by whom the art of type founding was first introduced into America.—W. W., Allentown, Pa.

(2698) Additional Rules for the Conversion of Thermometer Scales.—I find your rules apply very accurately for the conversion of the different thermometer scales, when the degrees are above zero, but I cannot make them work for degrees below zero. Are there special rules for the last named cases? or do I err in wrongly applying the rules you gave?—S. A., Steubenville, Ohio.

(2699) Postage-Stamp Mucilage.—Can you tell me how the mucilage on postage stamps is prepared?—C. H. H., Augusta, Me.

REPLIES.

(2689) Chian Turpentine.—Chian, also called Chio or Cyprian turpentine, is the resinous product of a small anacardiaceous tree or shrub, known to botanists as *Pistacia terebinthus* (*Linnaeus*), which is held to be synonymous with *P. atlantica*, *P. palaestina* and *P. cabulica*. Under the first form (*P. atlantica*) it is found in Northern Africa and the Canary Islands, where it grows to a large size. *P. palaestina* is found in Palestine and Syria, and *P. cabulica* extends eastward to Beloochistan and Afghanistan. In the true form of *P. terebinthus* it is common on the islands and shores of the Mediterranean and throughout Asia Minor. The plant varies in size from that of a shrub to a tree 20 to 40 feet high. Hamburg says of it: "The extreme variations certainly present great differences of habit, as any one would observe who had compared *P. terebinthus* as the straggling bush which it is in Languedoc and Provence, with the noble umbrageous tree it forms in the neighborhood of Smyrna." Respecting the resin itself, it is said the best is the resinous juice that is secreted in the bark of *P. terebinthus*, and is collected for commercial purposes chiefly in the island of Scio, either from spontaneous exudations or from incisions made in the stems and branches. From incisions the juice flows more freely, but the process is, nevertheless, quite slow. As the juice exudes, it either solidifies on the trunk or trickles down upon stones placed to receive it. To free it from impurities, it is subsequently liquefied by exposure to the sun, and strained. The average annual yield of a tree is from 8 to 10 ounces, and the quantity annually produced in the island is said not to exceed 850 pounds. The material, therefore, because of its scarcity, is somewhat expensive, and it is said that it is seldom met with perfectly free from adulteration with cheaper resins. It is described as being of a very stiff consistency, and often quite firm and solid, and as having a cloudy and sometimes opaque appearance, with a greenish-gray or greenish-yellow hue, possessing a very feeble though agreeable terebinthinus odor, and very little taste. It is very soluble in alcohol, amylic alcohol, glacial acetic acid and benzole—the solution being in each case slightly fluorescent. Until lately, Chian turpentine is said to have become almost obsolete in medicine, but of late much interest has been attracted to it by reason of the important series of investigations conducted at the Queen's Hospital, Birmingham (England), by Mr. John Clay, Obstetric Surgeon to the hospital, who, as we learn from the London *Lancet*, has proposed and used it in the treatment of cancer. "Hitherto," says this authority, "this terrible disease has proved incurable by medical treatment, but the inquiries and experiments conducted by Mr. Clay lead to the belief that by the use of Chian (or Cyprus) turpentine—which he has been the first to use—cancer cannot only be arrested, but cured, without a surgical operation." Mr. Clay reports the details of a number of cases successfully treated by the use of this remedy, which seem, in view of the hitherto utterly ungovernable nature of this terrible malady, to be very remarkable. Mr. Clay administers the remedy internally, either in the form of pills, or, where these cannot be well digested, then in the form of an emulsion. The recipe for the first is: Chian turpentine, 6 grains; flour of sulphur, 4 grains; to be made into two pills, to be taken every four hours. The recipe for the emulsion is as follows: Prepare an ethereal solution of Chian turpentine by dissolving 1 ounce of the resin in 2 ounces of sulphuric ether (anæsthetic). Take of this solution ½ ounce; solution of tragacanth, 4 ounces; syrup, 1 ounce; flour of sulphur, 40 grains; water to 16 ounces; 1 ounce three times daily. So far the published history of this interesting new remedy, which has appeared in the medical and pharmaceutical journals, and which we give our correspondent on their authority. We likewise refer him to the London *Lancet* of March 27th, 1880, in which he will find Mr. Clay's paper in full describing his investigations. From the above abstract, and the paper of Mr. Clay, our correspondent must draw his own inferences, since we have laid down the rule in this department to pass no opinion upon questions having a medical bearing.

(2690) Removing Silver from Plated Ware.—Several methods are recommended for this purpose. The most rapid and effectual is the following: Pour into a porcelain or enameled cast-iron vessel of suitable size, a quantity of concentrated sulphuric acid, and heat the same to about 300° Fah. At the moment when this bath is to be used, throw into it a few pinches of dry powdered saltpeter, and introduce the article to be de-silvered, holding it in the liquid with a pair of copper tongs, or suitably suspending it therein. The liquid rapidly dissolves off the silver; but if the coating is thick, the action of the liquid may diminish, in which case the addition of a few pinches more of the saltpeter may be found necessary. The work is finished when the articles, on being rinsed with water and again immersed in the cleansing bath, no black or brown spots present themselves, and the surface remains bright. Another method is to suspend the articles in a cyanide bath and reverse the poles of the battery, so that the current shall flow in the opposite direction to that followed in silver-plating. To recover the silver from the desilvering liquors, where the siver is in the form of a simple salt, they should be diluted with four or five times their bulk of water, heated to the boiling point, and the silver thrown down with muriatic acid or with common salt. The silver is all precipitated, when, after allowing it a few moments to subside, the addition of a drop of the acid or salt solution does not produce a turbidity in the supernatant liquid. The precipitated chloride of silver is then separated from the liquid, either by decantation and repeated washing with hot distilled water, or by filtration through a paper filter and repeated washing. It should then be mixed to a homogeneous paste with about four times its weight of dry carbonate of soda, and half its weight of powdered charcoal, dried thoroughly, introduced into a crucible and heated to bright redness. The heating should be continued for some time after fusion has taken place, to collect all the globules of silver together in the bottom of the crucible. The silver will be obtained in this case in the form of a button; or if it is preferred to granulate it, it should be poured in a thin stream from a hight into a large volume of water. Should the solution from which the silver is to be recovered, contain the metal in the form of a double salt, the precipitation of the silver cannot be effected with common salt, unless the double combination of the silver has first been broken up by the addition of a strong acid—as sulphuric acid. After this addition, the silver is in the condition of a simple salt, and can be precipitated with common salt. Muriatic acid alone, however, precipitates silver from such solutions of double salts. Liquors containing silver in the form of the cyanide are likewise exceptions. The best method of treating such solutions is to evaporate to dryness, and heat strongly. Then make several additions of nitric acid, evaporating gently over the water bath to dryness each time, dissolve in water with the addition of a little more nitric acid, precipitate the silver with common salt, or with muriatic acid, and proceed with the treatment of the resulting chloride of silver as above indicated.

(2691) Illuminating by Coal Gas.—It is now almost universally admitted that the sole credit of having first practically applied coal gas to the purpose of artificial illumination, is due to Scotchman named Wm. Murdock. It is not known when Mr. Murdock first turned his attention to this subject, but it has been assumed that he was attracted thereto by the publication of certain experiments made by Lord Dundonald, a Scottish nobleman, who secured a patent in the year 1787 for making coal tar, or, more properly, coal oil, by the distillation of coal. In condensing this product, the gaseous substances eliminated in the process of manufacture, were found to be inflammable, and were collected and burned for the entertainment of his friends. Murdock, a countryman of his lordship, then living at Redruth, in Cornwall, was led, by the account given of these experiments, to investigate the nature of the products of the distillation of peat, wood, coal, and other inflammable substances. He pursued these studies systematically, and found that by properly regulating the process of carbonization, he was enabled to obtain a uniform product of high illuminating power, and it occurred to him that by providing suitable receptacles for this gas, and conveying it in pipes, it could be manufactured and utilized on a large scale for the lighting of streets and houses. It is known that in the year 1792, he lighted his own house and offices in this manner, conveying the gas from his miniature gas works in pipes for a distance of 70 feet, and astonished his neighbors by adapting the gas to the lighting of a small steam carriage in which he daily rode to and from the mines of which he was manager. It was not, however, until the year 1798 that gas-light may be said to have been first introduced as a commercial and economical substitute for oil lamps and candles. In that year Mr. Murdock erected apparatus for the production of illuminating gas, at the manufactory of Messrs. Boulton, Watt & Co., Soho, Birmingham; and having entered into the employment of that firm, he personally superintended its manufacture, and projected the details of the operation. It was not until the year 1803, as we learn from Mr. Clegg, himself a high authority on the manufacture of coal gas, and a pupil of Messrs. Boulton, Watt & Co. at the time that these experiments were being made, that the Soho foundry was fully lighted with coal gas. In 1805, several large cotton mills were lighted by gas from apparatus constructed by Messrs. Boulton, Watt & Co., under the direct superintendence of Mr. Murdock and Mr. Clegg. The Lyceum Theater of London was the first place of amusement lighted by coal gas, and in a short time the advantages of the new method of illumination were recognized and its use became general. The details of its manufacture, purification and distribution were also gradually perfected. Baltimore was the first American city to adopt

lighting by gas, in the year 1816, and this example was followed in 1822 by Boston.

(2692) Lead and Mercury Poisoning.—The plan referred to by this correspondent is no doubt that of a Belgian professor, M. Melsens by name, who devised a method of treating cases of lead and mercury poisoning based on the administration of the iodide of potassium, the success of which was recognized in the award to him, in 1877, of the De Montjon prize of $500 by the French Academy, for the invention of a process for diminishing the risks of unwholesome trades. M. Melsens first pointed out the benefits of iodide of potassium as a means of successfully combating the ill effects of lead or mercury on the human body, some thirty years ago; and continuous experiments by others with the remedy since that time, have confirmed Melsens' first results. He considers the peculiar effects of lead and mercury on the human organization to be due to the presence of these metals in the organs affected; and his treatment consists in the administration of iodide of potassium in graduated doses, the action of the drug being, according to his idea, to induce the metal, which has been rendered insoluble by the formation of some albuminous compound, to take on a soluble form by the creation of a double iodide, which will be carried away in the urine. Of the success of Melsens' mode of treatment there seems to be not the slightest doubt. The committee appointed by the French Academy to inquire into its value, expressed the following opinion respecting it: "Numerous experiments in the course of thirty years have proved the practical value of this system of treatment. Workmen affected with lead paralysis have been cured; others, who were unable to follow their calling from their liability to lead colic, have been enabled to take it up again, fortified by a regimen of which a dose of iodide of potassium formed a part. The result of the observations made at Brussels, and the letters and certificates sent to the Academy, leave no doubt on this point. With regard to mercurial affections, the observations made by M. Melsens in person, have been confirmed by those made at the mercury mines at Idria. The workmen engaged in the manipulation of mercury and mercurial products at the Idria mines, have been made the subjects of various methods of treatment, curative and preventive, and the good effects of the iodide are no longer doubtful. At a special hospital in Vienna, ample occasion has been furnished to watch the action of the iodide in freeing the body from the presence of fixed mercury, and preventing its fixation. It has been found that in presence of the drug, the symptoms characteristic of mercury are removed, or diminished, or prevented from declaring themselves." From the above, it is obvious that Melsens has discovered a remedy of great value to those whose calling requires their exposure to liability of lead or quicksilver poisoning.

(2693) Weight and Volume of Different Substances.—Answering this correspondent, we append a table showing the weight per cubic foot, and number of cubic feet per gross ton (of 2,240 pounds), of a number of the materials he names. If any material that he specially desires to have is not included therein, we will be pleased to furnish the information respecting it if he will name it. We give the second column of figures in gross tons; should our correspondent desire the figures in net tons, he must divide the figures of weight per cubic foot into 2,000.

TABLE SHOWING WEIGHT OF VARIOUS MATERIALS PER CUBIC FOOT, AND NUMBER OF CUBIC FEET PER TON.

Name of Material.	*Pounds per cub. foot.*	*No. of cub. ft. per gross ton.*
Cast iron	450.5	4.97
Wrought iron	486.6	4.60
Steel	489.8	4.57
Copper	555	4.03
Lead	707	3.16
Brass	537.7	4.16
Tin	456	4.91
Pine, yellow	29.56	75.6
Pine, white	33.81	66.2
Mahogany	66.4	33.8
Marble	141	15.9
Millstone	130	17.2
Oak, live	70	32
Oak, white	45.2	49.5
Clay	101.3	22.1
Concrete, common	115	19.5
Brick	100	22.4
Plaster of Paris	105	21.3
Sand	94.5	23.7
Granite	139	16.1
Earth, loose	78.6	28.5
Water, sea	64.3	34.8
Water, pure	62.5	35.8
Ice	58.08	38.56
Gold	1,013	2.21
Silver	551	4.07

(2694) Weights of Casting and Pattern.—Our correspondent will find tables of this kind in "Rose's Pattern-Maker's Assistant," and the "Molder's and Founder's Pocket-Guide," both published by H. C. Baird & Co., Philadelphia; and in Spretson's "Practical Treatise on Casting and Founding," published by E. & F. N. Spon, London and New York. For his guidance, we give below, from the above named authorities, two tables of this kind:

A Pattern weighing one pound, made of	*Will weigh when cast in* Cast Iron.	Zinc.	Copper.	Yellow Brass.	Gun Metal.
	lbs.	lbs.	lbs.	lbs.	lbs.
Mahogany, Nassau	10.7	10.4	12.8	12.2	12.5
" Honduras	12.9	12.7	15.3	14.6	15
" Spanish	8.5	8.2	10.1	9.7	9.9
Pine, red	12.5	12.1	14.9	14.2	14.6
" white	16.7	16.1	19.8	19	19.5
" yellow	14.1	13.6	16.7	16	16.5

A Pattern weighing one pound, made of	*Will weigh when cast in* Cast Iron.	Brass.	Copper.	Bronze.	Bell or Gun Metal.	Zinc.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Pine or fir	14	15.8	16.7	16.3	17.1	13.5
Oak	9	10.1	10.4	10.3	10.9	8.6
Beech	9.7	10.9	11.4	11.3	11.9	9.1
Linden	13.4	15.1	15.7	15.5	16.3	12.9
Pear	10.2	11.5	11.9	11.8	12.4	9.8
Birch	10.6	11.9	12.3	12.2	12.9	10.2
Alder	12.8	14.3	14.9	14.7	15.5	12.2
Mahogany	11.7	13.2	13.7	13.5	14.2	11.2
Brass	0.84	0.95	0.99	0.98	1	0.81
Tin, with ¼ or ⅓ of lead	0.89	1	1.03	1.03	1.12	0.85
Lead	0.64	0.72	0.74	0.74	0.78	0.61

The slight discrepancies that may appear in these two tables, may be accounted for by the difference of densities of the materials. It is said that European woods are generally more dense than the corresponding woods in this country.

(2695) Number of Bricks in Walls and Massive Work.—The usual size of bricks in our Eastern cities is 8¼ × 4 × 2 inches, and taking these dimensions to be what our correspondent refers to in his question, we give him the following tabular statement on the authority of Trautwine's "Engineer's Pocket-Book." This author states, that, allowing for the usual waste in cutting bricks to fit corners, jambs, etc., the average number of 8¼ × 4 × 2-inch bricks required per square foot of wall, is as follows:

Thickness of Wall.	*Number of Bricks.*
8¼ inches, or 1 brick	14
12¾ " " 1½ bricks	21
17 " " 2 "	28
21⅛ " " 2½ "	35
25¾ " " 3 "	42

For massive work, he gives the following table:

Thickness of joints.	*Proportion of mortar to whole mass.*	*No. of bricks per cub. yd.*	*No. of bricks per cub ft.*
⅛	about one-9th	638	23.63
¼	" ¼	574	21.26
⅜	" three-10ths	522	19.33
½	" ⅓	475	17.60
⅝	" four-10ths	433	16.04

(2696) Artificial Gems.—The composition employed for making imitations of precious stones, is known by the name of strass, and may be called a glass containing a large percentage of oxide of lead. It must be made with great care, and by prolonged fusion. M. Dumas, a noted French chemist, gives the following as the composition of the strass now generally used for this purpose:

Silica	38.2 per cent.
Oxide of lead	53.0 "
Potassa	7.8 "
Borax, alumina, and arsenious acid	traces.

When the strass is properly made, all the precious stones, colorless and colored, may be imitated with it. For the latter class, the strass is melted and mingled with substances having a metallic base, generally oxides, which, combining with the elements of the strass, communicate to it the most varied colors. The following are a few of the more important formulæ employed:

Diamond.—This gem being usually colorless, pure strass cut into brilliants and roses, are used to counterfeit it.

Ruby.—Strass, 1,000 parts; glass of antimony, 40; purple of Cassius, 1; and 1 part, in excess, of gold.

Sapphire.—Strass, 1,000 parts; and oxide of cobalt, 25 parts.

Topaz.—Same formula as for ruby, but without the excess of gold, and heated for a shorter time.

Emerald.—Strass, 1,000 parts; oxide of copper, 8; and oxide of chromium, 0.2 part.

Amethyst.—Strass, 1,000 parts; oxide of cobalt, 25 parts; and a little oxide of manganese.

Garnet.—Strass, 1,000 parts, and a variable quantity of purple of Cassius, according to the shade to be imitated.

These are the principal gems. Others, like the pearl, turquoise, precious coral, aventurine, etc., are made by special processes. The pearl is generally imitated by the skillful glass blower, who blows little hollow spheres of glass covered interiorly with a species of enamel, which imitates the nacreous luster of the natural pearl. Aventurine, which is a variety of ferruginous quartz filled with minute glittering spangles, is imitated by a variety of methods; the most successful of these have long been practiced almost exclusively in Venice. Pelouze's procedure, which is said to give even better results, is as follows: He melts together 250 parts of sand, 100 parts of carbonate of soda, 50 parts of carbonate of lime, and 40 parts of bromate of potassium. The spangles in this case are produced by the precipitation of the chrome. This artificial aventurine is said to be even harder than the natural aventurine, and to take a beautiful luster.

(2697) Type Founding in America.—We are able to inform this inquirer, on the very reliable authority of "The American Printer," edited by Mr. Thomas Mackeller, that a foundry, principally for German type, and which is believed to have been the first in this country, was established in the year 1735, in Germantown, a suburb of Philadelphia, by Christopher Saur (or Sower), a printer, who executed, in the German language, the first 4to Bible printed in America, as well as other valuable works. The progress of this industry has been attended with many ups and downs, as the following summary of facts respecting it, from the same authority, will show: About the year 1768, Mr. Mitcheson, a Scotchman, made an unsuccessful attempt to set up a type foundry in Boston; and a similar failure attended the effort of Mr. Buck in Connecticut. Dr. Franklin, in 1775, brought from Europe to America the materials for such a foundry, but little use was made of them. John Baine, an Edinburgh type founder, sent a relative to this country with a plant for a foundry about the close of the revolutionary war, and soon after came over himself. They carried on the business until 1790, when, Mr. Baine having died, his kinsman returned to Scotland. A Dutch founder is reported to have settled in New York shortly afterwards, who cast Dutch and German faces, which were considered handsome; but he is said to have failed. In 1796, the art of type founding may be said to have first fairly obtained a foothold in this country, for in that year Archibald Binny and James Ronaldson (Scotchmen), the latter afterwards elected the first President of the Franklin Institute, commenced the business of type founding in Philadelphia. They were successful from the start, enlarged their facilities and the variety of their type to meet the growing demands of the printers' trade, and materially improved the machinery and tools used in the work. The establishment founded by them has had a continuous existence from that day to the present, and now probably ranks second to none in the world. In the succeeding twenty years, type foundries sprang up in various American cities—in New York, Boston, Cincinnati, Buffalo, Pittsburg, Louisville, St. Louis, etc. The first successful type-casting machine was invented by Mr. David Bruce, Jr., of New York, and was patented March 17, 1838. He improved this machine still further, receiving patents therefor in 1843 and 1845. It gave entire satisfaction, and is now in general use in American foundries. Up to the year 1874, there were three type foundries in Boston, seven in New York, one in Buffalo, three in Philadelphia, two in Baltimore, two in Cincinnati, one in Chicago, one in Milwaukee, one in St. Louis, one in Richmond, and two in California—in all, twenty-four. These foundries not only supply the printers of the United States, but most of the printers in Canada, some in the British West India islands, the Spanish and Danish islands, Mexico and South America. The quality of American type is affirmed to be equal, if not superior, to that of any made in Europe.

(2698) Additional Rules for the Conversion of Thermometer Scales.—Our correspondent is right in asking if there are special rules intended to apply to the conversion of the thermometric scales when the degrees named were below zero. The rules we gave were intended to apply to the cases which generally occur—that is, when the degrees are plus degrees, or above zero. For the minus degrees, the addition or subtraction of 32 is done in the reverse manner from that given for plus degrees; the rest of the rules apply as before given. For example: To convert minus degrees (Celsius or Reaumur) into Fahrenheit, multiply C. degrees by nine-5ths, or R. degrees by nine-4ths, and subtract 32. To convert −50° C. (that is, 50° below zero) into Fah., for example:

$50 \times \frac{9}{5} = 90$, from which subtract 32 (which we add for plus degrees) $= -58°$ Fah. To convert −50° R. into Fah.:

$$50 \times \frac{9}{4} = 112.5 \text{ and } 112.5 - 32 = -80.5° \text{ Fah.}$$

To convert minus degrees Fah. into Celsius and Reaumur, proceed as follows: Add 32 to Fah. degrees, and proceed as with + degrees, thus: To convert −50° Fah. to C.°

$$50 + 32 = 82 \text{ and } 82 \times \frac{5}{9} = -45.5° \text{ Celsius.}$$

$$50 + 32 = 82 \text{ and } 82 \times \frac{4}{9} = -36.4° \text{ Reaumur.}$$

We might add, while on this subject, that one sentence in our first reply might be interpreted to imply that alcohol thermometers were used to measure high temperatures, when they are, by reason of the low boiling point of that liquid, utterly unfitted for that purpose. This remark is made simply to avoid any possibility of misconstruing our remarks on the part of our readers. To finish this subject completely, it will only be necessary to add that should it be desired to convert Celsius into Reaumur degrees, or *vice versa*, it only requires to be borne in mind that since 80° R. = 100° C., 1° R. = five-4ths of a degree C.; and conversely, 1° C. = four-5ths of a degree R. To convert R. degrees to C. degrees, therefore, multiply R. degrees five-4ths. To convert C. degrees to R., multiply C. degrees by four-5ths, and the product will be the required answer.

(2699) Postage-Stamp Mucilage.—The formula for making the mucilage used on postage stamps is given on good authority as follows: Gum dextrin, 2 parts; water, 5 parts; acetic acid, 1 part; dissolve with the aid of heat, and add 1 part of spirits of wine.

THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 11. NOVEMBER, 1880. TWELFTH YEAR.

The Whitehill Improved Automatic Cut-Off Engine.

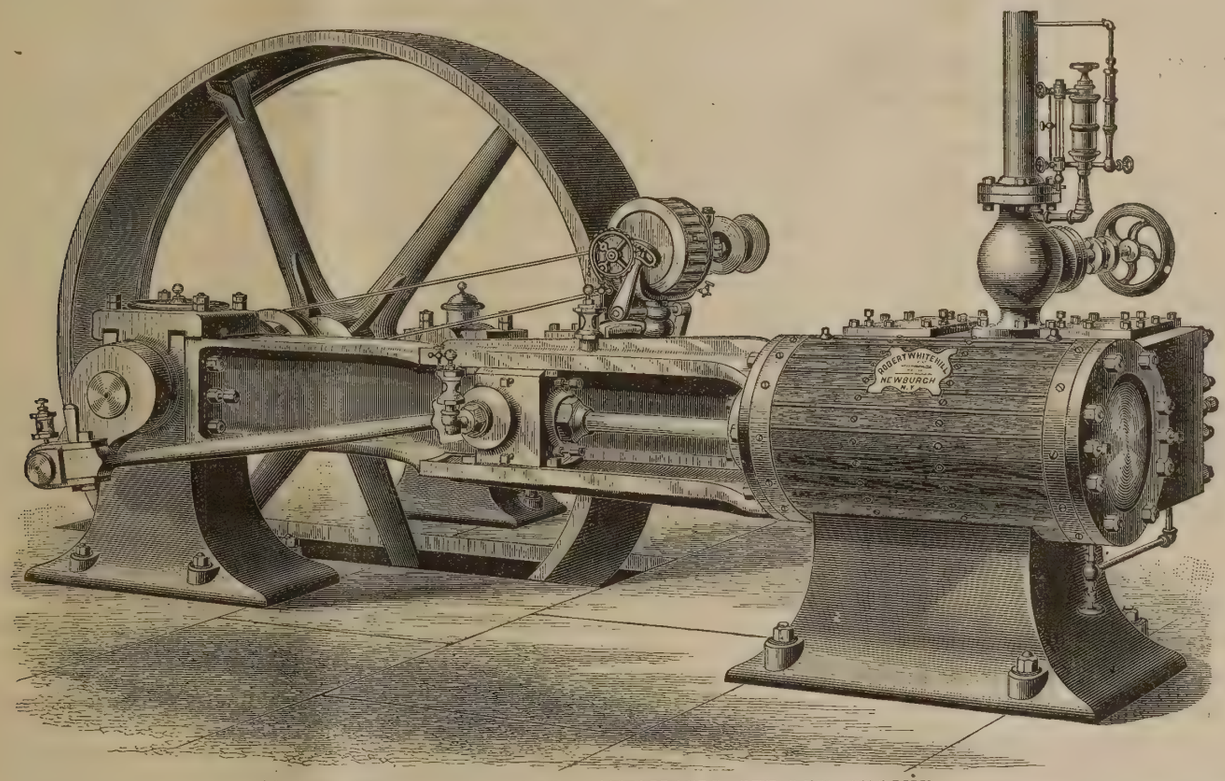
It is well known to all who are familiar with the theory and practice of steam engineering, that the highest duty and the closest approximation to perfect action of steam engines in practice, is secured by the adoption of the principle of using steam expansively. Like many other admirable principles, however, the utility of this one is not always as fully realized as it might be, by reason of the fact that in many of the forms in which it has been applied to engines, the devices have been encumbered by a multiplicity of parts, so complicated, and requiring such delicacy of adjustment to develop their full benefits, and on these accounts have demanded so much attention and expert attendance to insure their proper action, that their advantages are occasionally more than counterbalanced.

We illustrate herewith an improved form of the modern stationary engine, in which the principle of using steam expansively has been realized by the employment of an automatic cut-off, which is worthy of much commendation for its effectiveness and simplicity. The engine in question is manufactured at the Newburgh Steam Engine Works, Robert Whitehill proprietor, Newburgh, N. Y, and the engraving gives an excellent idea of its appearance. The design and proportions are excellent, the working parts are readily accessible, and of the best material, and with respect to excellence of workmanship in fit and finish, it will bear comparison with the best.

The special feature of these engines is the automatic slide-valve cut-off, with which they are provided. The maker, retaining the many good points of the plain slide-valve engine, has added certain features that perfect the valve mechanism, and has succeeded thereby in producing an automatic cut-off engine which admirably combines the important qualifications of simplicity, durability in service and effectiveness, as measured by the standard of high duty and economy.

As we do not show the details of the valve mechanism, we give simply a brief description of its construction and action. There are three valves—the main valve, the cut-off valve and the gridiron or governor valve. The main valve is the same as that usually employed, and regulates the admission and exhaust. It can be adjusted independently of the cut-off valve. The cut-off, or intermediate valve, slides on the back of the main valve, and is provided with a number of ports, which are controlled by the governor valve. The main and intermediate valves are driven by eccentrics, in the usual manner, the intermediate having a motion coincident with the piston. The governor valves are attached to the governor by simple rods and a crank, in such a manner that the governor, in raising, by reason of an increase of speed, thrusts the valves apart, and effects a cut-off, or closure, of the steam ports in the intermediate valve at an earlier period of the stroke. When its speed decreases, the governor valves are brought closer together, and steam is admitted to the piston for a longer portion of the stroke. The range of the cut-off is from the closest point to full stroke. When the engine is at a standstill, therefore, the cut-off is entirely out of action, and the engine can be started at almost any portion of the stroke.

In the perfection of these devices, the maker appears to have succeeded in overcoming whatever objection has been urged against the plain slide-valve engine, and in avoiding the fault of a multiplicity of parts and troublesome complications, which is properly urged against many forms of automatic cut-off engines. The steam is admitted to the cylinder at boiler pressure, the cut-off is prompt, and the quantity of steam used at each stroke is gauged exactly to the amount actually required by the engine to overcome its load. And this is accomplished by mechanism—simple, positive and precise in action, with the result of securing high economy and great regularity of speed under all conditions of service. This cut-off can be adapted to any plain slide-valve engine, with the result of greatly increasing its duty. The maker assures, with his improved valve mechanism, a gain of 20 per cent in power with the same engine, and greater regularity of speed.



THE WHITEHILL IMPROVED AUTOMATIC CUT-OFF ENGINE.

We hope in a future article to present our readers with a more detailed description of the valve mechanism of this engine, with illustrations, and with indicator cards showing its performance.

An engine of this description is furnishing the power needed to drive the machinery at the Fair of the American Institute, open at the time of this writing, and has attracted much comment in the technical journals for its excellent proportions, unique design, admirable workmanship, and noiseless and steady running.

Further information respecting these engines may be obtained by addressing the manufacturer, Robert Whitehill, Newburgh Steam Engine Works, Newburgh, N. Y.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XII. No. 11. TWELFTH YEAR.

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The following News Companies in the principal cities of the United States and Canada are agents for the sale of the MANUFACTURER AND BUILDER, and are prepared to supply the same promptly:

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Toronto News Co., Clifton, Ontario, Canada.

A Retrospect and Prospectus.

With another issue, the twelfth volume of the MANUFACTURER AND BUILDER closes. The promises made by us in our prospectus for this year have been more than fulfilled. Including the December number, nearly 300 pages of letter-press and illustrations will have been published, forming a handsome quarto volume replete with practical information on mechanics, building, engineering, science and other subjects of a useful character. The illustrations have been profuse, and in the highest style of the art. Hundreds of questions have been answered in our "Notes and Queries" columns on all subjects, and this department, always an interesting feature of our journal, has been enhanced by an unusual number of valuable communications. Twelve designs have been published during the year from the pens of some of our leading architects. Machinery of all descriptions, new mechanical devices, and illustrated science have occupied a large share of our space, while much information of a general character has been published.

In speaking for the future, we wish to state that our thirteenth volume will not be behind its predecessor. On the other hand, it will be our aim to enhance its value still more if possible, and we will spare no effort or expense to this end. We shall add new features as they suggest themselves, and will always be pleased, as in the past, to receive any suggestions our readers may have to make. Our editorial department will deal, as ever, with the current topics of the day; the mechanical portion of our columns will contain profusely illustrated descriptions of improved machinery and tools; our science department will contain the newest discoveries in this field; our home department will contain useful topics for the household; our market reports will continue to be full and accurate; an architectural design will appear in each issue; our "Notes and Queries" department will be given the same care as in the past; while our other departments will be kept up to their acknowledged present standard of excellence.

A large number of subscriptions expire with our December issue, and we would state to those wishing to renew, that it would be desirable to send their subscriptions in early to avoid any delay in receiving their future numbers. We trust that we may not only receive the renewals of all those whose subscriptions expire, but that each will endeavor to secure one or more new names.

The close of the Presidential question has already had the effect of animating business in all lines of trade, and especially among our manufacturers, and we think there can be no doubt that the coming year will be a most prosperous one for the whole country. The recent formation of a large number of new companies for manufacturing purposes, and other indications, all point to a thorough revival of confidence on the part of capitalists.

We look for a large increase in our advertising patronage, as well as to our subscription list, the coming year, and the large amount of inquiry we have lately received, leads us to believe that our anticipations in this direction will be amply realized. We thank our advertisers and subscribers for the generous patronage accorded us during the present year, and trust we may be favored with its continuance during the year 1881.

Shall England Dictate the Industrial Policy of this Country?

For the first time in the history of this country, a new element has made its appearance openly during the exciting presidential campaign through which we have just passed. The Cobden Club, a rich and powerful association of British manufacturers, the avowed purpose of which is to break down the protective systems of other countries, has gone to the length of openly interfering in our elections, and attempting to influence the people's choice of rulers, by flooding the agricultural districts with free-trade literature, specially addressed to the farmers of the United States. In full accord with the infamous object of the Cobden Club to destroy American industries and pauperize the American workman to the level of their own working classes, to the end that British trade may be benefitted and British commerce extended, is an organization known as the Free Trade Club, with headquarters in this city, an association of the importers and sellers of British and other foreign products, and the subserviency of whose members to the furtherance of the purposes of the parent organization will therefore be readily understood.

We are sure that every patriotic American who cares for the welfare of his country, with which the prosperity of our rapidly growing industries is intimately associated, will regard this remarkable procedure of the Cobden Club as an act of unparalleled and inexcusable impertinence, prompted solely by the selfish motive of furthering British interests to the detriment of ours.

The seal of the Cobden Club bears the philanthropic motto, "Free Trade, Peace, Good-will among Nations." We have had our full share of the good-will of the nation of which the Cobden Club is a representative institution—a nation that from the day when the early colonists of America landed on these shores to the present time, has lost no opportunity to show that our unexampled growth and prosperity were hateful to her. Open war with Great Britain would be fraught with consequences infinitely less serious to the future progress of this country, than the success of the insidious efforts she is now making to undermine the foundations of our industries that are developing into vigorous life under the vivifying influences of our protective policy.

England for centuries has been the workshop of the world. She has been able during this time to build up immense industries, backed with enormous aggregations of capital. To maintain her position as the supplier of manufactures to the world, she has shown that she will stoop to the uses of any means, however execrable, that give promise of success. Our only guide in judging of the future, is the experience of the past, and seen in that mirror, the nation that in the furtherance of her selfish commercial interests, forced the accursed trade in opium upon the Chinese at the cannon's mouth, makes a sorry figure as the exponent of the gospel of "peace and good-will among nations." We might instance certain recent examples of England's philanthropic interest in the welfare of this country, but our readers' memories will supply the omission.

The development of the vast manufacturing and commercial system of England was not accomplished in a day. It has been the slow growth of centuries, aided by certain natural advantages and political circumstances; and the very policy of protection she would have us abandon, was a most powerful and effective element in fostering the growth of her industries to their present splendid development, and the rod she used with unsparing hand to defend them against foreign competition.

The manufacturing industries of this country could never have attained to their present position save for liberal protection against the matured manufacturing organizations of England and other foreign countries. It is safe to say, in fact, that most of our now flourishing industries would never have had any existence at all without it. Their decadence, after years of struggle, and when they are beginning to exhibit every evidence of healthy vitality, would be a national calamity.

The time will come to us, as it has come in England, when our manufactures will be as fully developed and as thoroughly organized as hers now are. When we have attained to that position, then we may safely take the step she has taken, but not till then. Meanwhile, he is wilfully or ignorantly, the enemy of his country, who advocates free trade. The present effect of the adoption of such a policy, would be to crush out of existence many of our industries, to cripple others, to throw

hosts of busy workmen out of employment, and to reduce the wages of the rest to starvation figures; and on the prosperous "Western Farmer in America," to whom the philanthropists of the Cobden Club have specially addressed their specious fallacies, it would recoil with no less disastrous effect. The largest market for his agricultural products would be impoverished, by reason of the vastly diminished ability of the hosts of workingmen of the manufacturing districts (and of the other hosts of tradesmen who prosper when they prosper and suffer when they suffer) to buy. Armies of the unemployed workmen of the idle mills and workshops that free trade would bless us with, would swell the number of Western farmers, whose increasing surplus of corn and wheat would go begging for a market. England would take a fraction of it—at her own price—and pay for it in her manufactures at her own valuation; and without American competitors to keep her figures within reasonable bounds, her "iron lords and cotton kings" would fleece us to their hearts' content while preaching the gospel of "Free Trade, Peace, Good-will among Nations."

Canal or Railway?

It is interesting to notice that while the difficulties surrounding the organization of the several inter-oceanic canal projects appear to be on the increase, and doubts are even freely expressed in high quarters concerning the financial success of any canal that might be built across the American isthmus, the enterprising and indefatigable Mr. Eads has kept quietly at work in the interest of his favorite project of a ship railway across the strait. When this project was first broached, it attracted some attention because of its novelty and the high reputation of its originator as a successful engineer; but the idea of a canal was then uppermost in the public mind, and the ship railway proposal failed to make much impression.

Mr. Eads, however, is not the man to be easily diverted from the prosecution of an enterprise which he has undertaken. The history of his connection with the Mississippi River improvements, which he originated, advocated and fought through to a successful termination against the strong opposition of the United States engineers, has demonstrated that he has the courage to defend his opinions against all comers, and the grit and persistence to push ahead and succeed in spite of opposition. Mr. Eads is just now giving us another exhibition of those qualities which have made him the most successful of American engineers. He has taken diplomatic advantage of the divided councils and embarrassments of the advocates of the rival canal projects, and has been unobtrusively but effectively engaged in converting public opinion in favor of his ship railway. What the result will be time alone will determine. Meantime, it is becoming more and more evident that the canal projects are making little or no headway, and that Mr. Eads is very much in earnest.

The arguments which he presents in favor of the ship railway as a substitute for a canal, are certainly worthy of careful consideration. He asserts that a railway capable of transporting the largest vessels safely and expeditiously from ocean to ocean, can be built in half the time and for half the money that a canal would require. Of its practicability, he affirms with the utmost positiveness that there can be no question; in substantiation he shows that the idea is not a novel one, having been employed for carrying boats over the Allegheny Mountains forty years ago. At the present time, he points out, there is in operation, within a few miles of Washington, a railway upon which canal boats, heavily laden with their cargoes, are daily transported up a steep grade from the Potomac River to the canal above. In Europe there are, he claims, at least two railways of similar character now in operation. Surely then, he urges, if a railroad can be constructed of sufficient strength to carry a canal boat, there is no reason why one could not be constructed strong enough to carry an ocean vessel.

The objection that has been urged with great pertinacity, that it would be impossible to carry a large vessel in this way without straining or injuring her, he meets by quoting the opinions of the Chief Constructor of the British Navy, and other able engineers and architects, that it can be done with perfect safety; to which he adds his own opinion that this strain could not possibly be as severe as that experienced at times in rough weather at sea.

Against the several canal projects he advances the following objections: A canal with locks would be of questionable utility to commerce, since an injury to one of them would suspend operations along the whole line. Commerce would not seek a line exposed to the liability of such accidents. Another point that he makes is, that a canal once constructed cannot be enlarged to meet the wants of increasing commerce; and no one can predict, in view of the progress of ship-building, what the ships of the future will be. A number of canals constructed years ago of supposed ample size, are now useless, or nearly so. He is of opinion, likewise, that the cost of building a canal, either across Panama or Nicaragua, would greatly exceed the estimates that have been made, and when built, he affirms that the cost of maintenance of harbors, canal, repairs to locks and the like, would also be far in excess of what the canal advocates are willing to admit.

Mr. Eads' conclusions summarized, are given below. He declares that a ship railway can be constructed at half the cost of a canal with locks, and in half the time; that when constructed, a ship railway can be maintained and operated at a cost not exceeding that of a canal; that the largest vessels, with their cargoes, can be safely carried from ocean to ocean in half the time required for a passage through a canal; that the railway could be enlarged from time to time to meet the wants of increasing traffic; and that wherever a canal is practicable, there also a railway could be constructed.

The latest advices concerning Mr. Eads' movements and intentions, state that he is *en route* for the Mexican capital, with the view of obtaining the necessary concessions from and the coöperation of the Mexican government in favor of a railway across Tehuantepec. He goes well provided with official documents, and his reputation has preceded him. He has plenty of persistence, and a habit of succeeding when he embarks in any enterprise, and the canal advocates should take time by the forelock, or they may awake some day to find themselves forestalled.

Let Well Enough Alone.

The facilities which our sensible patent system, with its moderate charges, afford to inventors, should be increased rather than diminished. Some of our legislators in Congress seem to regard the patent laws of the country as a standing evil, and for some years past persistent efforts have been made to modify them. The men who figure as reformers of the patent laws, must either be ignorant of the benefits which our system of cheap patents has conferred on the country, by stimulating and encouraging the inventive talent of our native artisans to constant activity in the improvement of the arts and industries, or they are wilfully blind to them.

Our foreign competitors in trade are not so obtuse as these would-be reformers at home, the best proof of which is afforded by the fact that every modification of the patent systems of European countries that has of late been made, has been in the direction of a closer assimilation to our own. And in England especially, where the patent laws are almost restrictive in their operation towards the artisan class, by reason of the excessive fees that they impose, the clamor for change is becoming every year more imperative.

An excellent illustration in point, that might be instructive to those who wish to meddle with our present excellent system, is given in the following extract from the English *Industrial Record*, in which the editor comments upon a correspondent's statement of the alarming extent to which American inventions are being introduced into that country. The editor expresses himself as follows:

"In another column we publish a communication from an 'Old Inventor,' calling attention to the remarkably flourishing trade being carried on here in inventions, not of English origin, but of American production. 'Go where you will in London, American "notions," large and small, meet you at every turn—English inventions nowhere.' This is, no doubt, the case. We want no better evidence of the effect of the patent systems of the two countries. The smallness of the charges for a patent in the United States, enables almost every inventor to protect his discovery, and to quickly find a market for it if it have any value, while the extortionate charges of the English tariff prevent all but a few from obtaining that protection which patent laws were designed to afford. But an 'Old Inventor' does not regard our scandalously bad patent laws as the only disadvantage which the British inventor suffers in comparison with his American rival. He finds in our moneyed and commercial classes a short-sighted disregard of the important services of inventors, never characteristic of the same classes in America. 'Not only are her patent laws conceived and enforced for the encouragement and protection of inventors, but her capitalists and manufacturing classes are ever ready to assist inventors to develop and utilize their conceptions.' In the United States, 'let it be known,' he says, 'that an improvement has been discovered in machinery, a use found for a waste material, a new process devised in any industry, and the inventor has no difficulty in finding a market for his discovery. Such is not the case here. Let a man approach a manufacturer with a project for economizing labor, cheapening an article he is producing, or invite his attention to a new enterprise altogether, and he will be met with indifference, if not with suspicion, and dismissed as a "crazy inventor." Let him seek the assistance of a private capitalist, and he will fare no better. Rarely will he meet with sympathy or favor. Millions will be forthcoming in this country for any rotten foreign loan, but to invest in a patent is a "risky speculation."'

"It must be acknowledged," says the editor, "that there is much truth in these remarks. If America has wanted money for any particularly rotten financial scheme, she has been generally able to get it here, but she has meanwhile been very careful to invest her own capital in the extension of her industries and the development of the inventive faculties and ingenuity of her citizens. We have by no means shown the same sagacity. But we think that the apathy and indifference to the claims of inventors which have distinguished us in the past, and must still, to some extent, be charged against us, are disappearing, and a more enlightened and enterprising spirit prevails."

The moral to be drawn from the above, is to "let well enough alone."

Legal Prosecutions of Animals!

One of the most curious and entertaining scraps of Middle Age history that we have lately seen, will be found by our readers in an article on the above subject, from the pen of William Jones, F. S. A., in a late number of *Land and Water*, and a very full abstract in the September number number of the *Popular Science Monthly*. It seems almost incredible to modern readers that such childish and besotted superstitions should have found support and recognition even down to the close of the seventeenth century; and the reading of this paper will afford another and striking illustration of the degradation from which science has redeemed humanity.

From this paper we learn that animals were assumed to be responsible for their actions like men, and horses, bulls, hogs, rats, and even insects, were arraigned before legal and ecclesiastical tribunals of those days, solemnly prosecuted, cursed and excommunicated, and the whole judicial apparatus of society was brought to bear upon their trials and executions.

The Dowd Tunneling System.

The doubts that had been freely expressed in this journal concerning the safety of the system of tunneling adopted by the Hudson River Tunnel Company, have been in no wise lessened by the occurrence of the lamentable disaster in July last; and in their decision to continue the work upon the same plan as heretofore, by relying entirely upon the aid of compressed air to prevent collapse and irruption at the headings, the officers of the company assume a very grave responsibility. We have all along been of the opinion that the system on which this important work was being carried out rendered it extra hazardous to the men employed upon it, and we have no reason to change this opinion. Nor shall we be disposed to modify our views in the event of the successful completion of the work without further accident or disaster, for though "nothing is so successful as success," we shall attribute such an event more to good luck than to good engineering; and though the importance of the work now going on cannot be too highly estimated, it is to be feared that the precedent which its completion would establish as an evidence of the merits of the Haskins system of construction, would be dangerous and most unfortunate in its results. We are not animated in these adverse criticisms by a disposition to make capital on the strength of having pointed out the dangers incident to this method of tunnel construction, and of having distinctly indicated the nature of the accident that was likely to happen, and which subsequently did happen; but, on the contrary, by the conviction that the logical inferences which were drawn in this journal when the work was first proposed and the plans made public, are as correct now as they were then; and by the expectation that the unfortunate event that happened might have induced those in charge of the tunnel to modify their plans.

We have been led to the foregoing review of the affairs of the Tunnel Company by the examination of a system of tunneling devised by Mr. Olney B. Dowd, which so fully meets the requirements of safety, and the engineering requirements of economy and rapidity in execution, that we give it our decided approval. From an extended description of the plans of Mr. Dowd, which we have had the opportunity of carefully studying, we present an abstract embodying its substantial features, with such illustrations as will suffice to give a clear idea of its merits, of which our readers may be the judges.

The system we are here considering is presented to the engineering fraternity as a safe and rapid mode of tunneling the Hudson and similar rivers, being specially adapted for excavating and constructing tunnels in soft and treacherous ground, and under great pressure.

Its originator summarizes its salient features as follows:

1. It provides a shield absolutely safe for the workmen while passing through strata of hard and soft mud, quicksand, "land springs," poisonous gases, etc., and capable of passing boulders and making an entrance in rock.

2. It provides for excavating the immense amounts of silt, clay, etc., by steam power instead of manual labor, to insure rapid progress.

3. It provides for the construction of a tunnel with water and gas tight walls, having strength even under pressure of about 4 tons to the square foot, to allow a margin of safety of 50 to 1, and to resist the constant pounding of heavy trains on its inverted arch; at the same time it has the longitudinal rigidity of a tubular bridge, so that in parts passing through "land springs" or exceptionally soft pieces of ground, there is no danger of breaking out cross sections of the tunnel. (*Mem.*—Special attention has been called to this difficulty by able engineers, and this form of trouble was practically illustrated by the breaking out of portions of the Cleveland tunnel under Lake Erie, the sections retaining their cylindrical form and moving several feet from the line of the remaining tunnel).

4. The tunnel may be constructed cheaply and rapidly, and when constructed, its permanency is assured.

5. It is suited to form a water and gas tight joint in the rear of the shield, and to furnish in the front edge of the tunnel sections firm and reliable support for hydraulic jacks, by which the shield is propelled and guided.

The Dowd system is illustrated in Figs. 1 and 2. Fig. 1 represents a longitudinal section of a tunnel, showing the shield and other accessories of the system, and Fig. 2 is a front elevation of the shield. The shield, represented by A, is a cylindrical structure of iron of great weight and strength, and is of slightly greater internal diameter than the external diameter of the tunnel B. The shield is furnished with an adjustable head C, by which it is made water-tight in front. Into a circular opening at the center of this head the collar D is fastened by bolts. This collar serves as a bearing for the shaft E, which carries, about a foot in front of the shield head, a strong rotating tunneling arm F of steel, provided on each side with blunt-edge cutting tools. The shaft E with the tunneling arm F, is actuated through suitable gearing G, with the aid of oscillating steam or compressed air engines, shown in Fig. 1 opposite the cog-wheel G. Where steam is used, provision is made by simple means to free the working chamber from condensed steam and combustion products. Both shaft E and tunneling arm F are provided with connecting water passages, the latter having two longitudinal passages of this kind, shown by dotted lines in Fig. 2, which connect with water passages shown on both sides of the arm. A tube in the shaft is so arranged, that by proper connection the water will be driven through the side of the arm that is moving forward.

The method of operation is about as follows: The shield and accessories being in place, the shaft and its arm are slowly revolved, and small quantities of water are forced through the water passages of the shaft and arm, to soften the silt and clay as they are scraped from the heading by the cutters. By this means the material in which the arm works is kept in a semi-fluid condition, in which the arm meets with slight resistance. The shield is gradually forced forward by hydraulic jacks H H, the required number and strength of which will depend on the size of the tunnel and the nature of the work. Bars I I, connected with the pistons of the jacks by socket joints, reach back to the front edge of the iron tunnel, on which they have a reliable bearing. As the shield moves forward, the rotating arm cuts away the silt; this is mixed with the injected water as above described, and in semi-fluid condition is discharged backwards through pipes J J (Fig. 2) into the car K. When this car, which should be of considerable capacity, and is shown mounted on wheels running on rails, is filled, the gates L L controlling the influx of silt, are temporarily closed, the car is drawn to the mouth of the tunnel by a wire rope, and the load is dumped through a gate in its bottom.

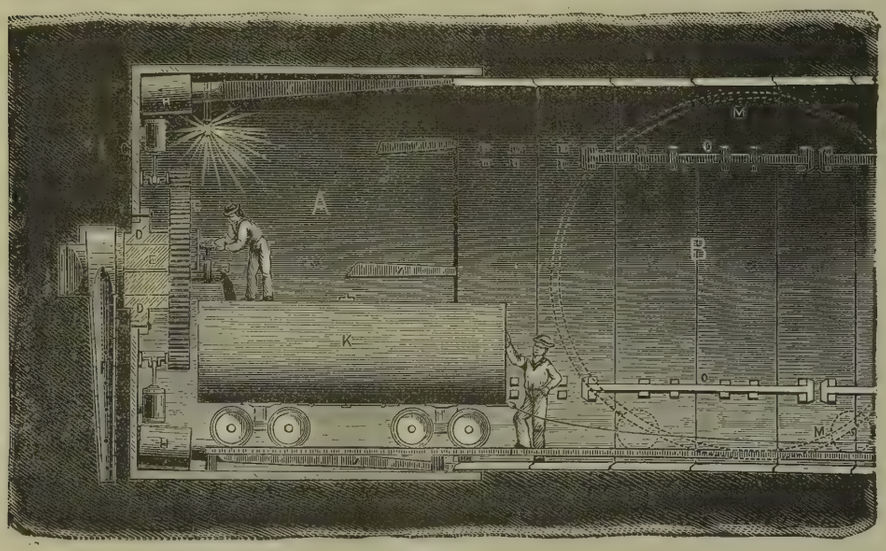


Fig. 1.

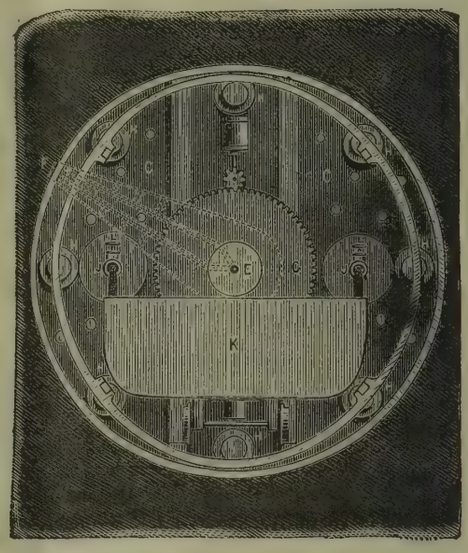


Fig. 2.

The tunnel proper is made of solid sections of cast-iron pipe, free from any longitudinal seams, a form which is considered preferable to any other on the score of strength and economy. Mr. Dowd proposes, for a railroad tunnel, a slight oval, about 17½ feet high by 16 feet wide, which would permit short 4-foot sections to be carried through the completed portions by turning their greater diameter at right angles with the greater diameter of the completed tunnel (see M M, Fig. 1).

The method of fixing successive sections in their places and forming tight joints, is as follows: When ready to be put in place, a wire-rope hoisting gear is attached to the section, and it is raised by steam power and set in its permanent position. The pushing bars are then replaced against it, the pressure applied, and the car, which has followed the section into the tunnel, is filled again as before. After being cast, and while still warm, the sections are coated externally with a thick rust-proof bituminous composition, which is applied by placing the section on its side, surrounding it with a sheet-iron hoop of the same width as the section, but about one inch larger in diameter, and filling in the annular space between the hoop and outside of the section with the hot composition. When set, it adheres to both. While this is done, the hoop is held by a frame coinciding with the form of the slightly elliptical opening in the rear of the shield through

which it is to pass, so that regardless of any irregularities in the rough casting of the section, the exterior of the hoop shall be suited to make a good joint in the shield packing, so that the rear of the shield may draw readily off from the hoop—which remains on the section—without allowing openings for the irruption of water or mud.

A portion of the coating material extends to the recess in the end of the section, to form a water-tight joint. When several of these sections are in place, and under pressure from the jacks, four steel or iron links O O, Fig. 1, are fastened, while hot, to lugs cast on the

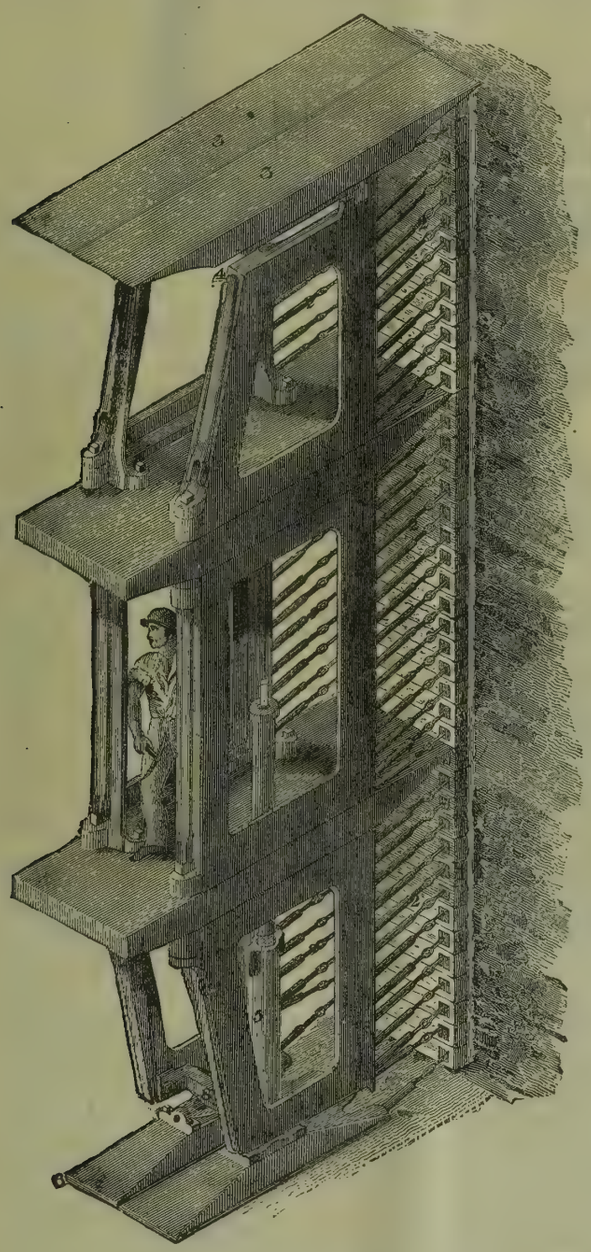


Fig. 3.

interior of the sections, so that as they cool and shrink, the sections will be held firmly in place. These bars are of such strength as to give the tunnel great longitudinal rigidity. The packing between the sections forms a water-tight joint, which admits of repacking from the interior in case of necessity. The collar D (Fig. 1) may be removed and taken into the shield with shaft and arm attached, when it is desired to renew the cutters, and means (not shown in the engraving) are provided to prevent the irruption of silt, etc., while this is being done.

When rock is to be pierced, the tunneling arm F is provided with special cutters, with which very good progress may be made through rock of moderate hardness; but when the rock is very hard, it is recommended, after making a safe entrance into it, to remove parts of the shield head and go on by the usual methods, passing the shield through afterwards and following with the iron tunnel.

Mr. Dowd gives the following estimate of the cost of two tunnels as designed for the Hudson River: Cost of iron (approximate), between $700,000 and $900,000; casting sections, $7 per lineal foot; excavating clay, silt, etc., putting sections in position, and placing tightening bars, about $7 per lineal foot, (Mr. Dowd is of opinion that by his method silt can be excavated at least 50 times faster than with the Brunel shield); cost of shield, from $8,000 to $10,000; dirt car, about $1,500; rust-proof coating and hooping the sections, about $5 per lineal foot; tightening bars, from $4 to $5 per lineal foot; hydraulic jacks, about 8 of which would be required, about $400 each.

Mr. Dowd is convinced that the inclined plane system is far the most desirable for passing trains through subaqueous tunnels, and recommends it for the Hudson River tunnel. In this system a long inclined plane is prepared, down which the train runs by its own weight. It is then raised over a shorter incline by means of an endless wire rope, which passes over a large wheel with a grooved face, and thence to the foot of the incline and around a small pulley, and it is moved like a belt by the large wheel at the head of the incline. The propelling power is a stationary engine. A special truck, with a clutching device, is used to make connection with the train; this is coupled with the ordinary cars, and is called a "pusher" or "puller," as it is used in front or in the rear of the train. This plan has the merit of being a rapid, cheap and safe mode of passing the trains. It preserves the purity of the air of the tunnel, permitting of its advantageous lighting; it permits the landing of passengers and freight at desirable points, instead of at great distances from the river, as is the case where long approaches are required; and the tunnel can be made much shorter, thus effecting a considerable saving.

For comparison with the above described system, we show in Figs. 3 and 4 a section of the Brunel shield used in constructing the old Thames tunnel. Fig. 3 shows it in perspective and Fig. 4 in side elevation. This section was 22 feet 3 inches high and 3 feet wide, and weighed about 10 tons. In the front were 44 poling boards, one above the other, which rested against the earth heading, and each board was held in

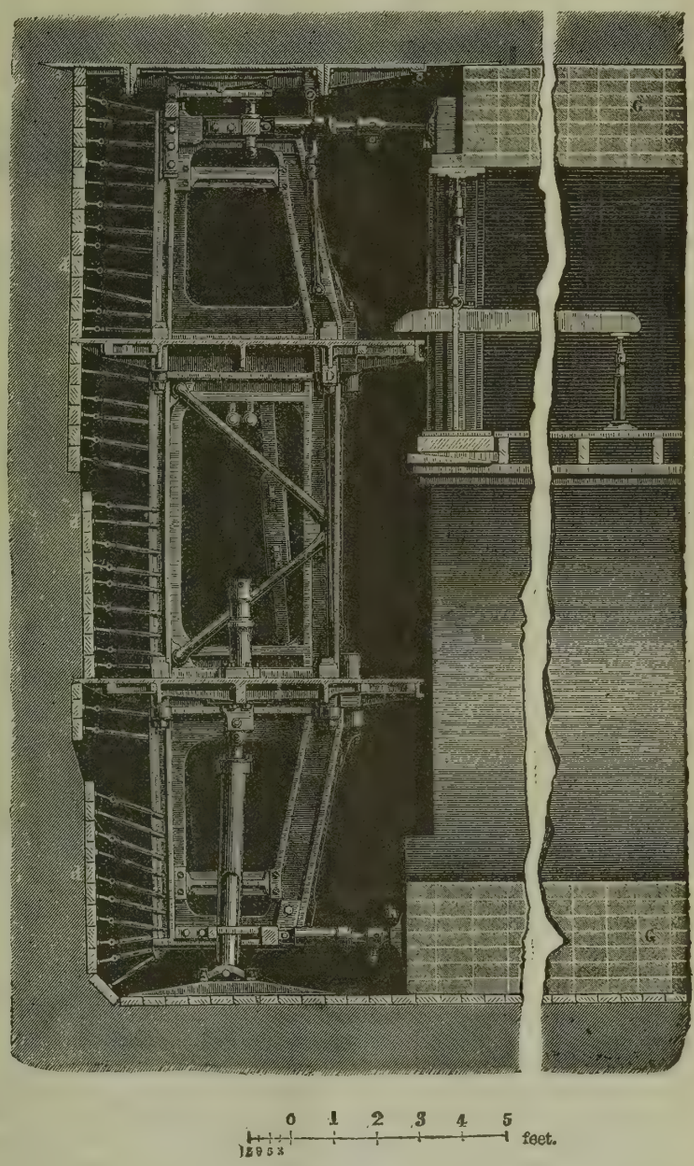


Fig. 4.

place by two jack-screws. Twelve of these sections were used, placed side by side. The sections were of the same form and size. When one was to be advanced, the highest poling board was removed, and the earth in front dug out, usually with the bare hand, so that this board should be a few inches further forward when replaced. The next board below was then removed and replaced in like manner, and so on until the whole section had been slightly advanced. Each of the 12 sections were advanced in the same manner, and the brick-work of the tunnel was built up as the sections were advanced. The progress of the work, with these appliances, was exceedingly slow, as may be judged from the statement that it took 17 years to build the 1,200 feet of the Thames tunnel. Its practicability, therefore, for a work of such proportions as the Hudson River tunnel, is utterly out of the question.

Figs. 5 and 6 represent respectively a longitudinal sectional and a cross sectional view of the iron shield used in the construction of the second Thames iron tunnel. This was simply a cylindrical tube of iron, slightly larger than the tunnel, provided with an iron head, in the center of which was a large opening (see Fig. 6). Laborers dug the clay from a space in front of the shield, passing it through this opening and out through the tunnel. The shield was then advanced by jack-screws into the space dug away, and a section of the iron tunnel was built up in the rear as fast as the shield was pushed forward. These sections were made up of smaller pieces, bolted together, as shown in Fig. 5, the joints being packed to make the tunnel tight and dry.

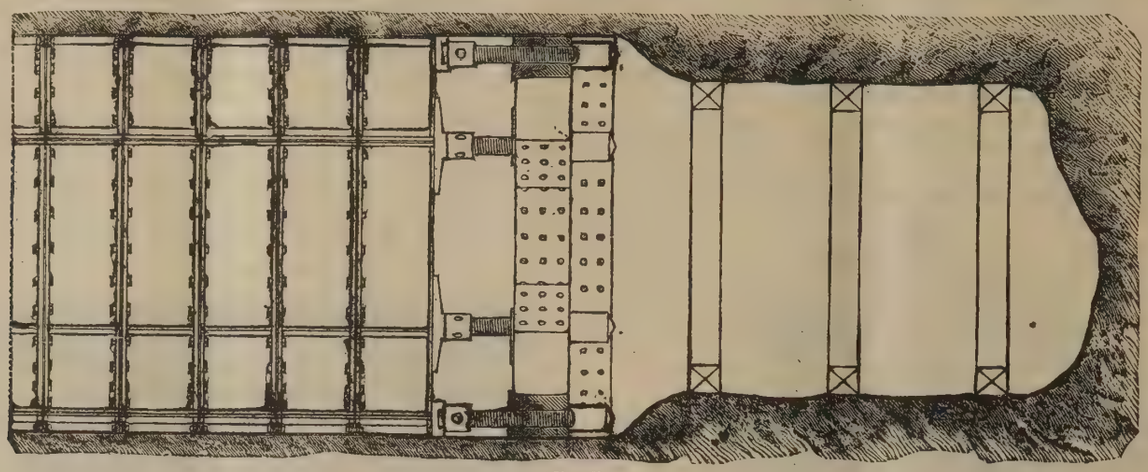


Fig. 5.

The Beach shield, shown in Fig. 7, consists of a short iron tube A, provided in front with an iron ring B, having a sharp cutting edge, and crossed on the interior with a series of shelves C, also sharpened, which are designed to penetrate sand or silt, and to prevent the same from falling too rapidly into the shield. A hand pump F is provided, which is connected with jacks D. These last advance the shield, and the tunnel is built up in the rear. This device appears to be specially adapted for dry-sand tunneling. It was used on a short section of the Cleveland tunnel, where the clay was not fully self-supporting. Neither of these last described shields, in Mr. Dowd's opinion, could be used in the difficult portions of the work under the Hudson River.

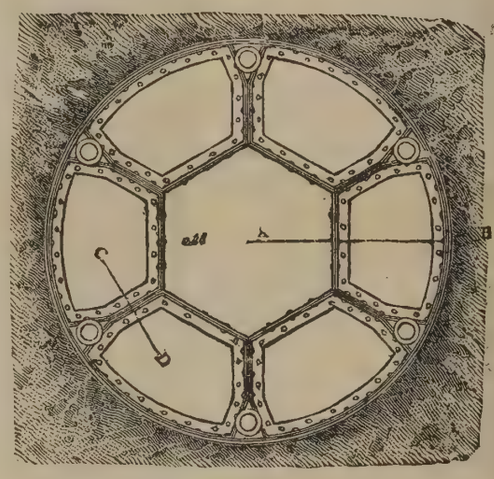


Fig. 6.

From the above description, our readers will be able to form an intelligent judgment of the value of the plans proposed by Mr. Dowd, which appear to us to meet the engineering difficulties encountered in subaqueous tunneling work, more satisfactorily than any system that has yet come to our knowledge.

Further information can be obtained by addressing Mr. Olney B. Dowd, Box 1980, New York.

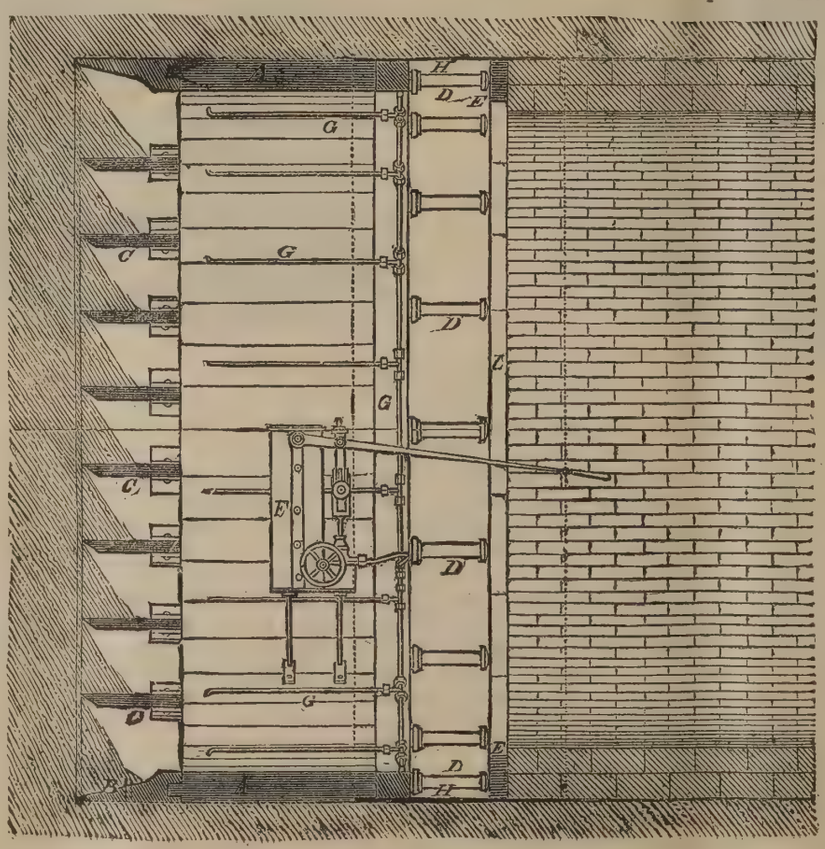


Fig. 7.

Cushioning the Reciprocating Parts of Steam Engines.

Mr. Charles E. Emery, in a discussion of a paper by J. W. Hill on the cushioning of the reciprocating parts of steam engines, sums up the principal considerations relating to the subject as follows:

The clearance spaces at each end of a steam cylinder include the clearance proper, as well as the passages and other spaces between the valve and the piston at the end of its stroke. These must evidently be filled at every stroke with steam at the maximum pressure admitted. This may be done in two ways, namely, by admission of steam directly from the boiler, or by closing the exhaust before the end of the stroke, so that the back pressure vapor will be compressed and the clearance spaces filled with cushioned steam equal—as nearly as practicable—to the initial steam pressure in the cylinder. In the first case, the cost is the quantity of steam taken from the boiler to fill the clearance spaces; in the second, the quantity of steam required in that particular engine to do the work of compression, supposing the net power furnished to be the same in each case. Generally, the second plan will have the advantage, for the reason that the steam required to furnish additional power will be worked expansively. There can be no economy of steam by cushioning when there is no expansion, and the full theoretical economy due to cushioning is not attained unless the steam is expanded down to the back pressure where the compression begins, which is undesirable on account of the losses due to interior cylinder condensation during extreme expansion. Hence, in practice it rarely occurs that the energy absorbed is entirely utilized during the return stroke. Again, cushioning is an indirect operation, so the economy resulting therefrom should be charged with a portion of the friction of the engine, since the total load is increased for the same net load. Cushioning also increases the average back pressure, which, under certain circumstances, may be a disadvantage. Moreover, in balancing advantages, it should be borne in mind that, if there be no cushion, the steam in clearances taken directly from the boiler would do work in an expansive engine. All these, and other conditions, must be fully considered to ascertain accurately the economy of cushioning, and until some one takes the time to formulate them, the common-sense view must prevail that cushioning is, in general, productive of a small economy of steam; that at least it causes no loss within the limits available with ordinary valve gear, and therefore may be used to any practical extent to produce desired mechanical effects. In practice, the question of economy becomes of secondary im-

portance compared with the mechanical advantages, and particularly is this so in the case of high pressure engines.

The Hotchkiss Improved Boiler Cleaner.

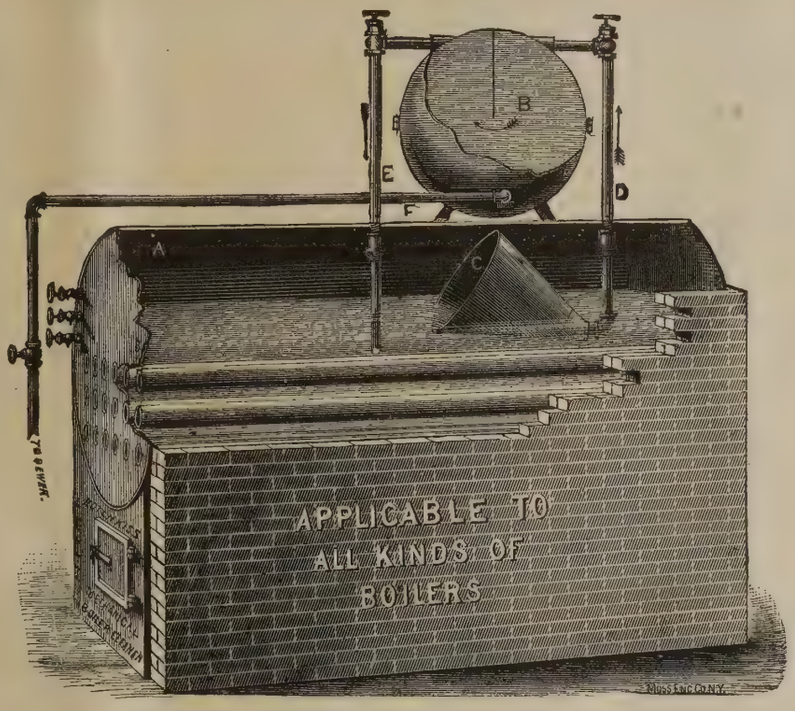
As we have had occasion to remark, the formation of scale is one of the most annoying and serious difficulties which steam users have to contend against. Where deposits of this kind are trifling in quantity, they give rise to no serious consequences; but where they become so thick as to threaten the closing up of the water spaces, or when they gather in considerable quantities on the plates and tubes exposed to a great heat, they not only become a source of annoyance and wasteful expenditure of fuel, but also of actual danger from explosion; and even though no serious danger should exist, their effect is to seriously impair the usefulness of the boiler and to shorten its life.

The most reliable estimates that have been made, place the conducting power of iron, as compared with that of boiler scale, at 37.5 to 1. These figures will convey some adequate notion of the exceedingly wasteful expenditure of fuel in making steam in an incrusted boiler, as compared with the fuel consumption of a clean boiler for the same duty. Rogers has figured the percentage of wastefulness as follows: "A scale one-16th of an inch thick will require the extra expenditure of 15 per cent more fuel, and this ratio increases as the scale is thicker—thus, when it is ¼ inch thick, 60 per cent more fuel is needed; ½ inch, 150 per cent more." It is apparent, therefore, that in a badly incrusted boiler, owing to the poor heat-conducting qualities of the scale, the fire surfaces must be far more highly heated to make steam of a required pressure, than in a clean boiler. In applying his figures to practice, Rogers gives the following statement in illustration: "To raise steam to a pressure of 90 pounds, the water must be heated to 320° Fah. In a clean boiler of ¼-inch iron, this may be done by heating the external surface of the shell to about 325°; but should ½ inch of scale intervene between the shell and the water, it will be necessary to heat the shell to about 700°, or almost to redness."

This example indicates to what an extent the transmission of heat is resisted by a thick coating of scale, and at the same time shows the serious danger that may result therefrom by the weakening of the iron from exposure for any length of time to excessive heating. It has frequently been observed in extreme cases of this kind, that plates have suffered from long-continued overheating from this cause to such an extent as to have become burnt through. But without resorting to extreme cases for illustration, it may be safely affirmed that the overheating, by reason of incrustation, may dangerously predispose a boiler to explosion long before the plates suffer greatly from burning, especially in the case of large furnace tubes, the softening of which may speedily be followed by collapse with disastrous results.

It will be unnecessary for us here to do more than briefly speak of the nature of these incrustations and the mode of their formation. Most waters used for boiler-feeding, contain solid matters in solution, which are either precipitated by elevating the temperature or are left behind on evaporation. Shortly after their separation, they are deposited on adjacent surfaces, and unless blown out, they become indurated and form incrustation. The impurities of well, mine, river and other waters that are chiefly responsible for the troubles of incrustation, are the carbonates of lime and magnesia, and the sulphate of lime. Of these, the first two are held in solution by the carbonic acid gas which all natural waters absorb to a greater or less extent, while the last is to some extent soluble in water. The first named compounds are precipitated by the heating of the water, which drives off the carbonic acid which holds them in solution; and the last is precipitated by evaporation, by which the salt gradually accumulates until the water becomes saturated with it, and so soon as this point is passed, its deposition commences.

The engraving shown herewith represents an apparatus designed for the purpose of removing the sediment from steam boilers as rapidly as it is separated from the water, and before it has an opportunity to deposit. The apparatus, which is known as the Hotchkiss Mechanical Boiler Cleaner, is highly spoken of, and while certainly possessing meritorious features, has the excellent qualifications of being very simple and inexpensive. Its construction and action will appear from the following description: The large iron bell mouth C is placed on, or so near, the tubes or flues as to bring the bottom of the mouth on a line with the low-water



THE HOTCHKISS IMPROVED BOILER CLEANER.

cock. This mouth is usually connected by a right and left nipple and elbow to the vertical up-flow pipe D, piercing the shell, as far back as braces will allow (or through the back head), and connecting with one side of the spherical reservoir B at the top. From the opposite side of the reservoir a return pipe E extends to a cooler stratum of water as near the bottom of the boiler as the tubes or flues will allow—the lower the better. This system of pipes forms a siphon, which, together with the difference in temperature between the surface and the point where the water returns to the boiler, causes a constant circulation of water as long as any steam remains in the boiler. In all boilers heated at one of their extremities, a circular motion of the water is established, which not only results in raising the solid bodies and agitating them, but also keeps them in constant motion in such a way that the surface currents always set back from the fire, while that at the bottom travels in the opposite direction, so that all matters contained in the water, whether originally held in suspension or precipitated from solution, are carried by ebullition to the surface, and there float until finally they are deposited upon the heating surfaces, and attach themselves in the form of scale, and this continues until the accumulations cause serious disturbance both in the amount of fuel required for evaporation and the danger of explosion from overheated plates. The Hotchkiss mechanical boiler cleaner is intended to remedy these evils by removing all sediment as soon as it rises to the surface. As the suspended matters are thrown upward by ebullition, the surface current carries them toward and into the large mouthpiece, and are thence carried by the circulation to the reservoir, where, the water being cooler and in a quiescent state, all solids precipitate to the bottom of the reservoir, and may be blown out through the blow-off pipe F, provided for that purpose.

For further information address the proprietor, Jas. F. Hotchkiss, 84 John street, New York.

Paper from Palm Fiber.

Seven varieties of palms are found in the South Atlantic and Gulf States, and two others on the Pacific coast. Those particularly utilized for the manufacture of paper by a company recently formed, are the saw palm, the cabbage palm and the dwarf palmetto. These, on account of their abundance and general distribution, are more readily obtainable than most of the others, which, however, may be made available when desired. They are indiscriminately termed palms and palmettos in different localities. The palms, or palmettos, as is well known, are indigenous to the South Atlantic and Gulf States, growing in many localities in such abundance as to become a nuisance. The palm-bearing region of the Atlantic and Gulf States, not including Texas, is estimated to cover over 100,000,000 acres, or more than 150,000 square miles, and more than half the area of the six States, South Carolina, Georgia, Florida, Alabama, Mississippi and Louisiana, where the principal growth of palm occurs. The greater portion of this region is readily accessible by water, thus involving little expense for handling and transportation of the palm, which can be freed from its refuse portions on the spot, leaving freight to be paid only on so much of it as is valuable for paper-making; it can also be pulped on the spot. The palm produced on a comparatively small portion of this region, is, because of its abundance and rapid growth, amply sufficient to supply paper for the world—a small part even of that growing in the single State of Florida would do this—and it is stated that no known material at all approaching American palm in value or applicability for making paper of good quality can be produced at anything like so small a cost.

Numerous experiments and tests, extending over a series of years, made by skilled, practical paper-makers, aided by scientific experts and men of experience in printing, engraving, lithographing and other judges of good paper, are said to corroborate the statement that this hitherto waste material possesses in a very high degree all the qualities requisite for the production of first-class papers of every grade, from the coarsest wrapping to the finest bank-note and proof-plate paper, including parchment, bank-note, proof-plate, photograph, drawing, ledger, writing-book, news and tissue papers. It is said to be, in fact, well adapted to all, equaling the fiber of linen in fineness and tenacity, and surpassing it in many qualities which are *sui genesis*, or peculiar to itself, while its cost is much less. Its superiority is, however, declared to be more particularly pronounced in the finer grades of paper, such as proof, bank-note and bond. This superiority is attributed to the peculiar structure of its fibers, and other qualities which give it distinctive characteristics. The paper made from this material is attractive in appearance, and experiment has shown that the fiber must be entirely destroyed to deprive it of its peculiar lus-

ter. The yield of useful paper stock from the raw material exceeds that from wood. In fact, it is asserted that the numerous advantages possessed by the palm, when properly treated, place it in the very first rank of paper-making substances, leaving out of consideration the cheapness of the raw material.

The raw material itself presents no particular difficulty in working. It may be treated the same as other material, and can be used without the admixture of any other fiber, while its cost, according to the *Journal of Applied Science*, is only that of the unskilled labor employed in cutting and packing it and transportation, and the pulping and conversion into paper cost no more than that of ordinary stock.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

Wm. E. Dodge is about to build a picture gallery adjoining his residence, at an expense of $25,000.

S. D. Hatch has prepared plans for the Methodist Episcopal church to be erected on 71st street, near Ninth avenue.

At No. 4 and 6 West Eighty-fifth street, a four-story brick dwelling, 34 by 100 feet 5 inches by 24 by 100 feet 5 inches, is to be erected. The cost is to be $120,000; owner, W. J. Hutchinson; the architect is Geo. B. Post, and the builders A. A. Andruss & Son, and Meeker & Hedden.

Heerlein, builder, has just completed, on Fifty-ninth street, 114 feet west of Eighth avenue, and within a stonethrow of Central Park, four imposing apartment houses, fronting 100 feet on Fifty-ninth street, and 88 feet deep. Two of these apartment houses have a frontage of 30 feet each, and two are 20 feet wide each.

The Bar Association of this city owns a vacant piece of land, 30 feet in width, adjoining its large building on Twenty-ninth street. The project in using this ground for an addition to the main building has been under discussion for some time. At a recent meeting a resolution was passed, approving of such a step, and the executive committee was instructed to get architects' plans for a structure not to exceed $25,000 in cost.

The plans which have been adopted for the new opera-house at Madison avenue and Forty-third street are described as preliminary, no arrangements having been made respecting the interior decorations. The Board of Directors met last week at Drexel, Morgan & Co.'s office, and adopted designs and specifications for the building. It also directed the Executive Committee, of which E. P. Fabbri is the chairman, to conclude the purchase of the land and proceed with the work. The building will be of pressed brick with terra-cotta trimmings, fronting 200 feet on Madison avenue, and 190 feet on the side streets. The walls will be ninety feet high, surmounted at the front by a pitched roof and tower, the whole to be 110 feet high. The architecture is a mixture of Italian and composite, without much ornamentation. The auditorium will seat 3,000 persons. It will be divided into the parquet, or orchestra, the parterre, or first row of boxes, two additional tiers of boxes, a balcony and a gallery. There will be 110 boxes altogether, with small ante-rooms. Each box will seat five persons, and will be 7 feet 8 inches high from floor to ceiling. There will 788 seats in the orchestra, 580 in the balcony, and room for 1,180 in the gallery. The interior will be plain, no money being wasted on decorations. Special attention will be paid to heating, lighting, and the means of exit. The auditorium will be surrounded on each of the five floors by a grand corridor. The stairways will be of iron and marble, and there will be three stairways from each tier on each side of the building. Two of these will be entirely independent of the others, and will go directly to the street. All of them will be inclosed by fire-proof walls. There will be four escape exits from the parquet. The stage will be practically in another building, because of the heavy walls. The stage opening, forty-eight feet wide, and forty feet high, will have an iron curtain to be lowered at the end of each performance. Fire mains will be placed in all parts of the house, to be supplied from tanks under the roof. The principal tank will be connected with a "factory sprinkler," a series of pierced pipes by which the entire stage and scenery can be deluged at will. The prevailing colors of the interior will probably be gold and maroon. The proscenium arch will be inclosed by a large square bronze frame flanked on each side by two richly decorated pilasters. These will support a frieze bearing a large allegorical painting with statues on each side representing Poetry, Tragedy, Comedy and Music. The main entrance will be on Forty-third street, the stage being on the Fourth-fourth street side. The committee will probably have to await the arrival of W. H. Vanderbilt from Europe before completing the purchase of the land, but it expects to break ground within a short period.

Miscellaneous.

The Boston & Albany Railroad Company are building a new car repair-shop 300 by 60 feet at East Albany, N. Y.

D. K. Dean, of Erie, Pa., is the architect of the new school-house at Edinborough, Pa., which is to cost $15,000.

Frank E. Davis, architect, of Baltimore, is preparing drawings for a new school-house, at Lancaster, Pa., to cost $10,000.

P. T. Barnum will build at Bridgeport, Conn., the winter quarters for his greatest show, the buildings to be done Nov. 1.

A three-story almshouse, 175 by 200 feet, is building at Mercer, Pa., at a cost of $50,000. Drum & Steen, of Pittsburgh, are the architects.

Thirteen new stations are to be constructed along the extension of the St. Paul, Minneapolis & Manitoba road. They will be each two stories in hight.

Dern & Pitcairn are building a three-story brick block, at Altoona, Pa., to be occupied by the Daily Tribune Co. E. Ale, architect.

A rectory for St. John's Church is to be built at Clifton, Staten Island, at a cost of about $10,000, from designs of Arthur Gilman, of this city.

G. L. Norrman, architect, of Spartansburg, S. C., is receiving estimates for building a town-hall at Newberne, S. C. It will probably cost $16,000.

The Pennsylvania Salt Manufacturing Co. are adding to their works at Greenwich Point, Philadelphia, a building, 88 by 200 feet, two-stories, for manufacturing sulphuric acid.

The managers of the Hebrew Orphan Asylum, in Philadelphia, have under contemplation the erection of a building that will accommodate one hundred children; it is to cost about $30,000.

Drum & Steen, of Pittsburgh, Pa., are the architects for the new Westmoreland County Home at Greensburg, Pa. It will be three stories high, and will measure 236 feet in length; cost, $63,000.

A site has been selected for the erection of ten buildings, for manufacturing purposes, on Albany street, Boston, Mass. The ground measures 640 by 75 feet. The estimated cost is about $175,000.

The Trustees of the Thos. Wilson Sanitarium Fund have commenced the erection of a Sanitarium on the corner of Charles and Saratoga streets, Baltimore. The building is to cost $28,000. Charles L. Carson is the architect.

A Presbyterian church is being built at Atchison, Kansas, of native blue-stone in rock face broken ashlar work, finished with Cottonwood Falls limestone; cost, $18,000; B. J. Bartlett, of Des Moines, Iowa, is the architect, and Rockwell & Gordon, mason contractors.

A Home for Aged and Infirm Poor Israelites is to be built at Philadelphia, to be known as the Abraham S. Wolf Home. The building is to accommodate fifty people; to be built at a cost of $10,000 or $15,000, and will be erected on the grounds of the Jewish Hospital. An additional wing is also to be built to the Jewish Hospital, to be used as a hospital for incurables.

A grain elevator is being built in Boston for the New York & New England Railroad Company. The dimensions are as follows: Length, 162 feet; width, 80 feet; hight of tower, 136 feet. It will be ready for use in March, and the cost will be not far from $200,000.

Samuel O. Gleason is to erect a large building at Troy, N. Y., and is to have it ready for occupancy by February 1, 1881. The structure will be of brick, five stories high including basement, and will be 35 feet front by 100 feet in depth. It will cost, including the lot, $50,000.

At the Wharton Railroad Switch Company's Works, on Washington avenue, between Twenty-third and Twenty-fourth streets, Philadelphia, there is being erected a building, 50 by 145 feet, designed for an engine-room, boiler-shop and machine and erecting shop.

A building for stores and business purposes is being built at the corner of South, Essex, and East streets, Boston, for Leopold Morse. The three fronts are of Jonesboro granite, showing 70 feet on Essex street and 114 feet on South; Louis Weissbein, Boston, is the architect.

At Cleveland, O., the Brush Electric Light Company are building large L shaped works on the corner of Wason and McHenry streets. The dimensions are 265 by 300 feet, one story, 17 feet in the clear; cost, $35,000; Wm. Wright, of Newburgh, N. Y., contractor; Blackburn & Charlotte, architects.

Plans have been prepared by James H. Windrim, architect, for a new armory for the First Regiment, at the corner of Broad and Callowhill streets, in Philadelphia, to be 140 by 224 feet; total cost, $240,000, two-thirds in the building itself. The plans represent a stone structure, built in rock-face mason-work, two stories high.

Among the extensive manufacturing improvements occurring at the present time in Philadelphia, are to be found those of George Campbell, manufacturer of woolen yarns, who will, in addition to his present mill, corner Twenty-first street and Washington avenue, have, by the first of the year, completed a large factory building on the square bounded by Reed and Dickinson streets, and Thirtieth and Thirty-first streets; main building 65 by 380 feet, two stories high, with a lantern roof extending over the whole length of the building. The structure will be lighted by 246 windows. In addition to the above, an engine-house, 12 by 49 feet, a boiler-house, 32 by 48, and a picker-house, 17 by 36, are to be built.

The plan of the permanent exposition building to be erected in Boston by the New England Manufacturers' and Mechanics' Institute on the Back bay provides for a ground area of 196,000 square feet of available space for exhibition purposes, and a second floor of 100,000 square feet. This building is to be so arranged that the whole ground space can be thrown into one exhibition room, or can be divided into a number of rooms, as may be found desirable, as the applications for space come in each year. One half of the whole 196,000 square feet can be used for machinery, if occasion requires, or a smaller area, as needed and the same method may be pursued with regard to other exhibits, if desired by exhibitors.

St. Paul, Minn., has built $403,500 worth of business blocks this year, $168,300 of public buildings, $268,000 of mills, elevators, etc., $749,100 of private buildings, and $270,000 worth of railroad structures. The new St. Paul elevator, just finished, cost $150,000, and there are some half-a-dozen new mills and factories, whose average cost reaches $20,000. The railroad buildings include the new union depot, $75,000; the St. Paul and Omaha shops, $67,000; and the Northern Pacific and St. Paul and Omaha general buildings and freight-houses, $60,000 each. The public improvements by the railroad companies, in addition to the actual erection of buildings, have involved the expenditure of $210,000 the present season, while the public improvements by the city and street railroad, water and gas corporations have cost nearly $200,000 more.

Maxim's Automatic Regulator for the Electric Light.

In previous articles descriptive of the improvements in electrical machinery devised by Mr. Hiram S. Maxim, we have referred to his self-regulating lamp. This is a very important element of his electric lighting system, and, as will be seen below, the devices which he employs meet the difficult conditions of the case in a very ingenious and practical manner.

The principle upon which Mr. Maxim has proceeded in the construction of his regulating apparatus, is to utilize the electric current itself to feed the carbons. No purely mechanical device can be successfully used for this purpose, since with all the care that may be bestowed in making them, it is quite impossible to produce carbon poles that will be perfectly uniform in composition, and the slightest difference in density or homogeneity at once affects the passage of the current, and consequently the steadiness and brilliancy of the light; the poles also, by wasting away irregularly, throw the light out of center. It is obvious, therefore, that any regulator for the electric light to be successful, must operate on the principle of controlling the feed of the carbons by the electrical current itself, and the regulating devices must be so accurately constructed and so delicate in action, as to be sensitive to any trifling variations in the carbons themselves, so that their motions shall be contracted within very narrow limits.

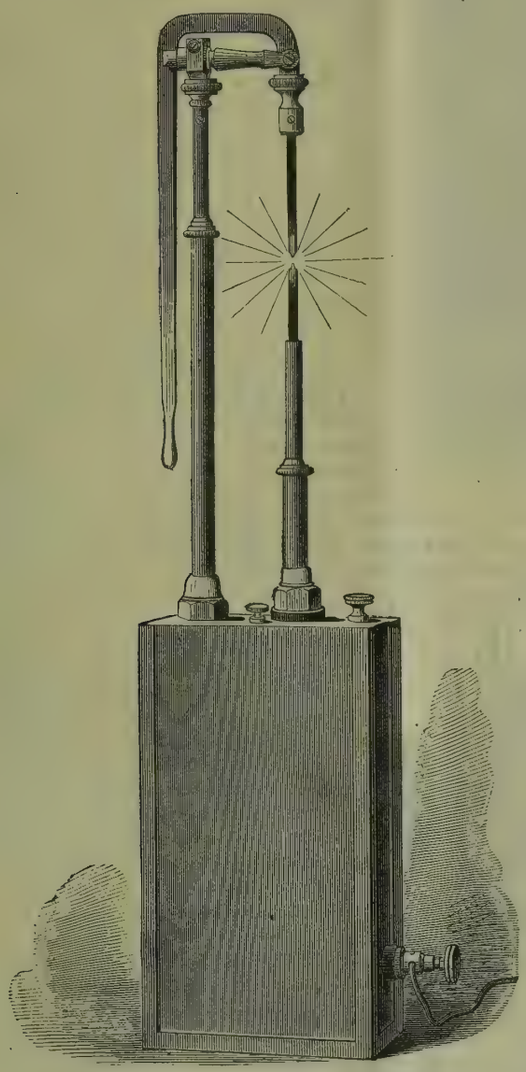


Fig. 1.—Maxim's New Focusing Electric Lamp.

An inspection of the accompanying engravings in the following description, will show how fully Mr. Maxim has comprehended the difficulties we have pointed out, and how ingeniously he has met and overcome them. In the engravings, Fig. 1 represents a perspective view of the lamp and Fig. 2 a section through the case, exhibiting the regulating mechanism. Referring to Fig. 2, A and B are tubes in which the carriers of the positive and negative carbons respectively operate. The positive carrier A is provided with a rack, partially seen in the cut, and which engages with a train of toothed wheels. The lower end of the negative carrier is provided with a pulley D, whose movement is controlled by a cord that is lengthened or shortened by the movements of the train of gears that actuate the positive; E is the coil of an axial magnet; G is an adjusting screw which determines the length of the voltaic arc; and F is a stop for arresting the train of wheels when the light is extinguished.

The action of this regulator is as follows: Connections having been properly made, the positive carrier is drawn up to its highest position and the carbons inserted in their respective holders. The weight of the positive carrier causes it to slowly descend, carrying the positive pole with it, and setting in motion the train of gears. At the same time, the cord of the pulley from which the negative carrier is suspended, is wound up, carrying the negative pole upwards, until the combined movement of both carriers brings the poles in contact. This completes the circuit, and the current at once commences to pass. At the same instant the helix is excited the coil E is drawn downward. Being attached to a detent, this downward motion of the coil E locks the gearing, and at the same time it draws down one end of the cord which supports the negative carbon, which likewise slightly descends. The trifling separation of the two poles by the descent of the negative pole, establishes the voltaic arc, and the lamp is lighted. As the carbons are consumed, the resistance becomes greater by the lengthening of the arc, and the power of the current to excite the helix is correspondingly diminished. The excitement of the helix is lessened, and the coil E is drawn upwards by the pull of a retractable spring seen in the engraving, the tension of which is adjustable, to insure extreme delicacy of action in the apparatus, and which the coil is no longer able to oppose. The spring pulls the coil upwards until the detent unlocks the gears, thus setting the train again in motion, and causing the carbons to approach each other as before described, until the arc is sufficiently shortened, when the current, having been restored to its original strength, again draws the coil downward and locks the gears. The construction of this ingenious regulator is so accurate, and the adjustment of its parts so nicely effected, that the locking and unlocking of the gears is accomplished by very trifling variations in the electro-motive force of the current, and consequently the movement of the carbons is controlled within very narrow limits.

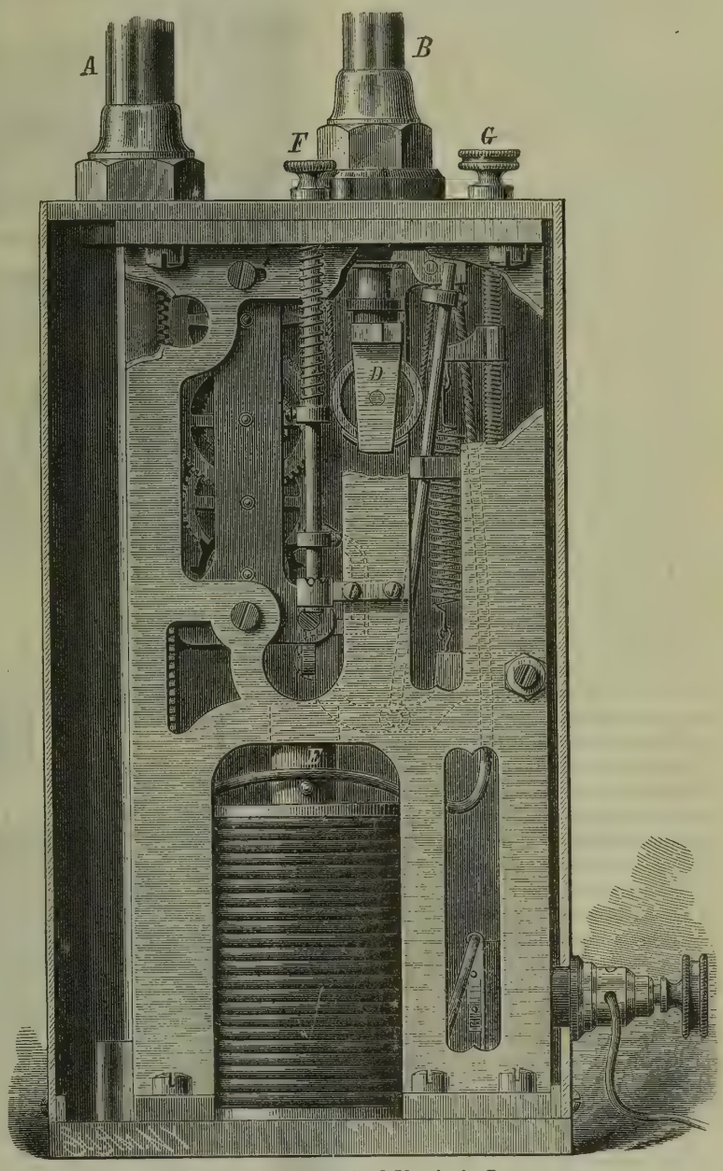


Fig. 2.—Movement of Maxim's Lamp.

From this description, it will appear that Mr. Maxim's regulator is perfectly automatic in action, and controls the light by means of variations in the intensity of the electric current, whether these proceed from the consumption of the carbons and the consequent lengthening of the arc, or from want of uniformity in the carbons themselves. It is claimed, as a proof of the superior delicacy of this form of regulator, that tests have shown that machines of all makers run lighter on this lamp than on any other, and with much less fluctuation of power.

Further information may be had on application to the United States Electric Lighting Company, 120 Broadway, New York.

When to Cut Timber.—July and August are the best months for cutting timber, that it may be the most durable. The growth of the year is then well nigh over, and if the trees are allowed to lie until the green foliage dries upon them, the greater portion of the sap is thereby withdrawn from the wood, and the seasoning is rapid and perfect. Cut in midsummer, insects are much less liable to attack the wood, which is an important point with some kinds of timber, like hickory.

The Hudson River Tunnel.

In our issue for August we gave an account of the disaster at the Hudson River tunnel, caused by the caving in of the roof of the temporary entrance leading from the air-lock to the tunnel proper, and accompanied the same with an illustration showing the nature of the work and the location of the accident, by which twenty lives were lost. Immediately after this unfortunate occurrence, the tunnel company's officers adopted measures for repairing the damage done to the work and for the recovery of the bodies of the lost workmen. It was decided, after some consideration, to sink a coffer-dam around the damaged portion, as this seemed to be the simplest and speediest method of accomplishing the desired objects. It was discovered, however, after the work had been for some time under way, that the very porous and unstable character of the soil through which the coffer-dam had to be sunk, was a serious obstacle to the progress of the work. The soil above the location of the accident, as will be recalled by most of our readers, is made ground, being composed of loose filling; and after the expenditure of considerable money and time, the effort to sink the dam had to be abandoned, as the water found its way through the porous soil in such quantities that it was found impossible to keep the interior of the dam free from it by pumping.

After the failure of this attempt, the tunnel officers decided upon sinking a caisson—a species of diving-bell which is frequently employed by engineers in sinking the foundations for bridge piers and other subaqueous structures. The caisson in question, which is shown in the accompanying engravings, is seen to be a structure of timber and iron, built in such a manner as to insure great strength. It is made air-tight, except at the bottom, which rests upon the soil to be excavated (see Fig. 1). The interior of this box forms a chamber in which the men work, and the lower edges are provided with sharp lips, which facilitate the gradual sinking of the structure as the soil is excavated from about them. The roof of the caisson is built of strong timbers, solidly braced, and filled in with cement (as seen in Fig. 2). The ends and sides of the structure are built of heavy planking, strongly braced by longitudinal and transverse timber cross pieces and iron tie-rods, as seen in the cuts. The working chamber has an arched ceiling, and its dimensions are 41½ feet long, 25 feet wide, and 18 feet high. Passing through the roof of the structure, and communicating with the working chamber, is an iron flue, provided with an air-lock above. Through this the men and materials are passed, and compressed air is admitted to the working chamber. The air pressure prevents the issuing of water through the soil on which the men are at work; and as the work of excavation progresses, the platform of the caisson above is weighted with railroad iron to overcome the interior air pressure and cause the structure to descend. The caisson is kept in a vertical position by means of suspension rods extending from the outer edges of the caisson to strong timbers above at the ground surface. These rods are provided at their upper extremities with screw-nuts, which are turned to permit of the adjustment or descent of the structure. The operation and use of the air-lock, which is seen as a lateral extension on the upper end of the air flue, have been so fully explained in our former article on the tunnel that we have no occasion to repeat the explanation here. A similar method is practiced here as in the tunnel excavation of getting rid of the excavated earth. The men fill the stuff in a box (shown in Fig. 1), where it is mixed with water to form a fluid mush, in which condition it is carried up and discharged through a pipe provided for the purpose. The two openings shown in the lower part of our cuts represent the mouths of the portions of the twin tunnels already built, and the place where the unfortunate workmen are buried is indicated in Fig. 1 by the broken line above them, marked "Broken arch plates."

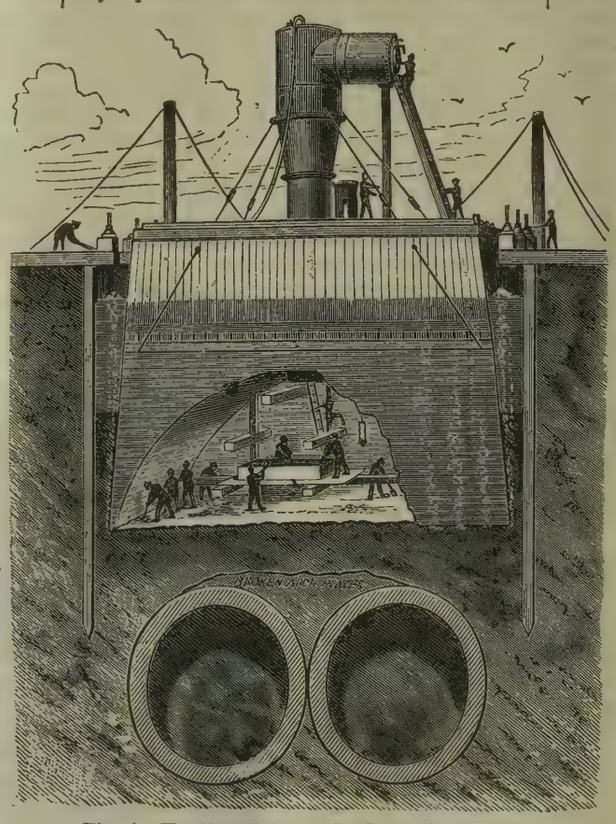


Fig. 1.—The New Caisson—Hudson River Tunnel.

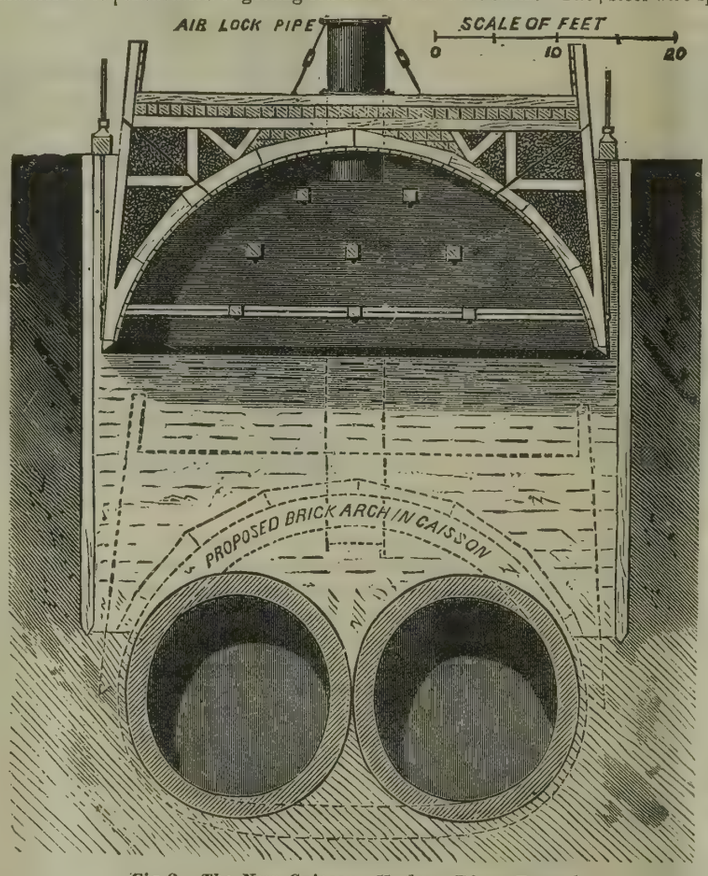


Fig 2.—The New Caisson—Hudson River Tunnel.

At the time of writing, the caisson has been sunk to its proper depth, and the bodies of a number of the men have been recovered. It is intended, so soon as the debris has been cleared away, and all the bodies have been recovered, to build a single broad arched tunnel within the caisson which will close the mouths of the twin tunnels. This single tunnel will subsequently be continued on proper grade to the surface of the ground in Jersey City.

So far as we are advised, there will be no change in the method of driving the tunnel, and so soon as damages are repaired, the work will be prosecuted as heretofore. Concerning the propriety of this decision, we have already expressed decided opinions, and can only hope that the character of the soil that will be encountered, and other incidental circumstances, will be sufficiently favorable to insure the completion of this notable piece of engineering without further accident or delays.

Annealing in Boiling Water.

An English expert on metal working, Prof. W. Mattieu Williams, says: "I will narrate some curious experiments that I commenced when in Sheffield, but have not satisfactorily completed. They were made at the suggestion of Mr. William Bragge, then a managing director of Sir John Brown's works. He had learned that the steel wire springs of piano-fortes are annealed by what appears a very ominous process, namely, by making the wire red-hot and then plunging it into boiling water. Ordinary experience would suggest that this must harden the steel in some degree, but I tried upon many samples of steel—mild Bessemer steel, shear steel of different qualities, and the hardest old-fashioned Sheffield 'pot steel'—and found that in every case, when the operation was properly performed, the steel was remarkably annealed. I compared samples cut from the same bar—one heated and slowly cooled by burying in ashes under a furnace grate, the other by immersion in boiling water—and found that when subjected to bending tests, those which had been cooled in boiling water would bear a more severe degree of flexure without cracking than the pieces which had been more slowly cooled in the ashes. They were not so soft, as tested by the touch of the file, but unquestionably tougher and more reliable when subjected, while cold, to the violent bending blows of a hammer. It was more effectual than any device of 'oil toughening' or slow cooling I have had opportunities of testing.

"Certain precautions are necessary. In the first place, the water should be just at the boiling point and the steel at a bright red heat; and, secondly, the steel should be fairly surrounded by the water. These conditions being fulfilled, the steel remains red-hot under the water for some time. It is evidently surrounded by a film of vapor, and is not in actual contact with the water, which assumes the so-called 'spheroidal

state,' continuing in this condition until the metal has cooled considerably. I suspect that the toughening is due to the uniformity of cooling thus effected.

"I commend this method of annealing or toughening to the attention of manufacturers engaged in the production of all kinds of steel that is to be used for purposes where tenacity rather than hardness is demanded."

How to Make and Use Glue.

A writer in the *Furniture Gazette* gives some practical hints on glue and glueing. His method of making the common cement is as follows: Break the glue into small pieces, put it into an iron kettle, cover the glue with water, and allow it to soak twelve hours; after soaking, boil until done. Then pour it into an air-tight box; leave the cover off until cold, then cover up tight. As glue is required, cut out a portion and melt in the usual way. Expose no more of the made glue to the atmosphere for any length of time than is necessary, as the atmosphere is very destructive to made glue. He adds: All the glue as received from the factory requires the addition of water before it will melt properly, and every addition of water (while the glue is fresh made) will, up to a certain point, increase its adhesiveness and elasticity. Some glues will bear more water than others; but all will bear more water than usually falls to their share, and that, too, with a greater improvement in the quality of the work. For glue to be properly effective, it requires to penetrate the pores of the wood, and the more a body of glue penetrates the wood the more substantial the joint will remain. Glues that take the longest to dry, are to be preferred to those that dry quickly, the slow-drying glues being always the strongest, other things being equal. Never heat made glue in a pot that is subjected to the direct heat of the fire or a lamp. All such methods of heating glue cannot be condemned in terms too severe. Do not use thick glue for joints or veneering. In all cases work it well into the wood in a similar manner to what painters do with paint. Glue both surfaces of your work, excepting in the case of veneering. Never glue upon hot wood, or use hot cauls to veneer with, as the hot wood will absorb all the water in the glue too suddenly, and leave only a very little residue, with no adhesiveness in it whatever.

Building with Tempered Glass.

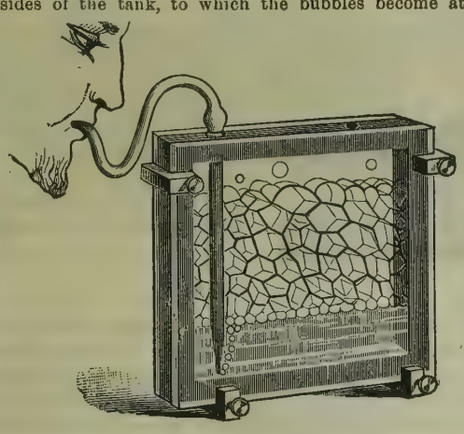
We lately entertained our readers about ties of tempered glass for railroads, obtained by Siemen's method. A new application of this method has been pointed out to us which would have appeared incredible at the time, when glass was only known in its primitive condition, as a crystalline product, with sharp, broken edges, yet fragile and unresisting to shocks and pressure. Tempered glass can be obtained in great pieces, gifted with a power of resistence, which its specific lightness, compared with heavy metals, would not have given the least presumption. It can now be employed, notably in carpentry, for posts, joists, ties and buttresses. It combines the advantages of strength and of incorruptibility in contact with all atmospheric agents, as well as with chemical factors, and consequently, is of perpetual duration. Besides these advantages another is the smallness of the price of acquisition. This material is now as cheap as iron of the same weight, and as a large sale is counted on, it will not be long before the reduction of price will be below the cost of wood. No doubt many industries will profit from this new progress in the fabrication of glass, and it will be greatly appreciated in the household. One will see the time when the metals and wood will be replaced by glass, in a great number of implements, utensils, and objects of diverse nature, such as stop-cocks, gutter spouts, buckets, and even barrels.

Very Powerful Argand Gas Burners have been devised by Mr. Sugg, an English gas engineer of eminence, for street and out-door illumination, intended to take the place of the electric light. A number of lamps, provided with these burners, have been erected in certain prominent thoroughfares in London, and are highly commended. Several of these lamps are of 200-candle power each.

Illustration of Cell Formation.

The accompanying cut illustrates in an ingenious and striking manner the phenomenon of the formation of cells in vegetable structure. The illustration originated with Mr. D. S. Holman, whose microscopic accessories were described in our September number, and, as will shortly appear, was devised for the purpose of showing the experiment to a large audience by means of the stereopticon.

The apparatus, which is of the simplest nature, consists merely of a plate-glass tank, with sides and bottom formed of a rubber strip, and made water-tight by the use of clamps. In this tank a quantity of soap solution is placed, which is raised into bubbles by a current of air blown into it through the glass tube, as shown in the engraving. In the contracted space in which these bubbles are formed, their disposition to take the shape of spheres, which they would form normally, is arrested by the capillary attraction of the sides of the tank, to which the bubbles become attached, and in consequence they spread in connected films across the tank. As the mass of bubbles increases, their mutual pressure upon and against each other modifies their normal spherical form to polygonal forms analagous to those to be seen in cross sections of wood fiber. If the air current has been delivered with regularity, the resulting films will be quite uniform in size, and generally of hexagonal shape, the form that naturally results from the exertion of uniform pressure upon each other by forms or structures having a circular section—the six-sided structure of the honey-comb being a familiar illustration of this fact. Where the air current, however, has been irregular in force, the bubbles vary in size and assume other polygonal forms besides hexagons.



As intimated at the outset, the illustration is intended to be shown as a lecture experiment to a large audience, for which it is admirably devised. We are told that although the engraving shown herewith gives the general appearance of the tank filled with bubbles, it can give but the faintest idea of the beauty of its image when projected upon the screen, which brings out the most gorgeous display of colors, resulting from the interference of light rays that fall upon them.

Moral Power of Machinery.

Machinery has a moral power. It has helped to build up substantial character in the nation, has broadened and made sensible the views of men, and removed such silly pride far more strikingly than could anything else. It has shown work, physical as well as mental, to be of paramount importance, to possess inherent elevation of the highest kind, and to be not only respectable, but honorable in the extreme. Thus it has enhanced activity among individuals who work from choice, while those inclined to be idle and to nurse the shallow aristocratic notion, which before the advent of labor-saving machinery considerably prevailed, that the less a man does of useful labor, the more he can lay claim to the character of a gentleman, have been stimulated to exertion, as they saw work, on a grand and powerful scale, embodied in machinery, and noted the tremendous results accomplished before their eyes. The people have not clearly recognized the influence, but they have instinctively felt its molding.

The Projected Florida Ship Canal.

The survey of the route of the proposed ship canal across the peninsula of Florida has been completed under the direction of Gen. Q. A. Gillmore, who reports in favor of the work. The principal direct benefits expected are the saving of about 500 miles in the passage from our Atlantic ports to Gulf ports, and the avoidance of the dangerous passage through the Florida Straits.

From published accounts we learn that the eastern terminus of the canal is fixed at Camp Pinckney, at the head of ship navigation, and 29 miles above the town of St. Mary's. From here it will run southwesterly to and through the Okefinokee Swamp, crossing the Suwanee river near Blount's Ferry in Columbia county, and thence to Ellaville in Madison county. At first it was contemplated making St. Marks the western terminus of the canal, but Gen. Gillmore failed to approve this selection, owing to the increased distance involved. The St. Mary's river is ascended by means of seven lift locks, each of 15 feet lift to the summit level—108 feet above tide. No guard lock is required, as the lift of the first lock exceeds any rise or flood in the river. The summit level enters the Okefinokee Swamp, through which it extends 22 miles—11½ miles above Camp Pinckney. Fourteen miles beyond, the Suwanee river is reached, near Blount's Ferry, the waters of which will be raised by means of a dam to the hight of the summit level and taken into the canal. Crossing the river in the lake so formed, the canal continues 18 miles beyond to the end of the summit level, which has a length of 62 miles. From this point the line descends by two locks, each of 10 feet lift, crosses the Alapaha, and, turning again to the south, crosses the Withlacoochee river near Ellaville, and thence runs through the center of San Pedro Bay, descending from it by five locks of 15 feet and one of 10 feet lift, directly to the level of the gulf.

A channel will have to be dug from the mouth of the canal to the deep water of the gulf, 7 or 8 miles from the shore. The projecting jetties will form a harbor of safety for shipping. The length of the canal route is about 169 statute miles, or 147 nautical miles, divided as follows:

From the bar to the mouth of St. Mary's	5.5
Navigation of St. Mary's River to Camp Pinckney	34.0
Canal	122.0
To deep water in gulf	7.5
Total	169.0

The plan contemplates a cross section of canal 80 feet wide at the bottom and 25 feet deep. The water surface will be 180 feet in width. The canal is widened, however, to 155 feet at the bottom and 255 at the top for 1,000 feet above and below each pair of locks, to permit the approach of vessels, and there are passing places 1,600 feet by 30 feet every six miles.

The locks are 500 feet in useful length (from the end of the gate chamber to the face of the breast wall), 65 feet wide at the gates, with 25 feet of water on the sills. They are arranged in pairs, side by side, to prevent the interruption of traffic during repairs, and the walls are carried to 5 feet above the water-line. The lifts are 10 and 15 feet. The locks have about the same dimensions as those advised for the Panama route, except in the matter of lift.

The estimated cost of the canal is $50,000,000. The drainage area available for the summit level is 1,200 square miles, with an average annual rainfall exceeding 4½ feet.

Review of the Cause of the "Seawanhaka" Disaster.

We present this month, from the monthly record of the Hartford Steam Boiler Inspection and Insurance Co., a masterly review of the causes that led to the recent disastrous explosion and burning of the steamboat "Seawanhaka." We give this report as published by the company, slightly condensed and with a few unessential omissions, to accommodate it to our somewhat limited space. It is substantially as follows: On June 28, 1880, the passenger steamer "Seawanhaka," plying between New York and Glen Cove, on Long Island Sound, on her afternoon trip from New York, when in the vicinity of Hell Gate, a dull noise (described as that of a muffled explosion) was heard, accompanied by a slight jar, and flames were observed to burst out amidships, beyond the possibility of control. The passengers, of whom there were a large number, became panic stricken, and the captain determined to beach the boat at what he thought the nearest available place upon the sunken meadow at Randall's Island. The fire, meantime, raged with such violence that in 30 minutes from its discovery the boat was burned to the water's edge. Thirty-five lives were lost, and many were badly burned and injured.

The "Seawanhaka" was a side-wheel steamer of 612 tons, built in the year 1866, single low-pressure beam engine, cylinder 56 inches diameter, 10 feet stroke, two boilers of the flue and return tube construction, which had been in continuous service until the day of the disaster—about 14 years. Each boiler was 21 feet long, 7 feet 8 inches in diameter; fire-box part, 8 feet wide, 9 feet long, and containing two furnaces; the heat, after leaving the furnaces, passed into a combustion chamber, thence through flues to the back connection, turning upward, it returned through a nest of tubes to the front end, and out of the chimney.

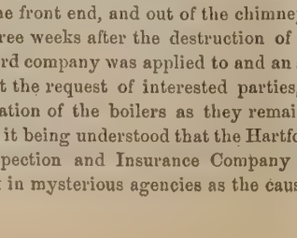


Fig. 2.

Over three weeks after the destruction of the boat, the Hartford company was applied to and an agent was detailed, at the request of interested parties, to make an examination of the boilers as they remained upon the wreck, it being understood that the Hartford Steam Boiler Inspection and Insurance Company took but little stock in mysterious agencies as the cause of boiler explosions, and there were reasons for the belief that the fire that destroyed the "Seawanhaka" was caused by the explosion of the boiler, or some of its appendages, and it was thought a careful examination might discover the defect and clear away the fog that surrounded the case.

In our illustrations, Fig. 1 gives a longitudinal section through the shell of the boiler, showing the smoke (gas) thoroughfares in elevation, and a section through the starboard furnace; C, the initial rupture in the bottom of the lower tube in the second vertical row, through which the water escaped; A, rupture in the right-hand 10-inch flue, probably secondary, through which water also escaped into the smoke (gas) thoroughfares; N N, the low places where the water lodged, the arrows representing the free steam which separated from the water as soon as it reached the chamber N; W, the ash-pan bedded in fire brick and cement; P, probable location of the wood-work that first took fire. Fig. 2 is the front elevation of the boiler, showing the opening in the tube plate made by the boiler maker, shortly after the accident, for the purpose of removing the ruptured tube, which was the lowest one of the second vertical row from the right hand. Fig. 3 is a section of tube and flap, showing half of the opening and flaps. The part above *a* was not found. Fig. 4 is a section through the back smoke chamber, giving a rear view of the rear tube plate, with the ruptured tube omitted; A and B are the ruptured 10-inch flues.

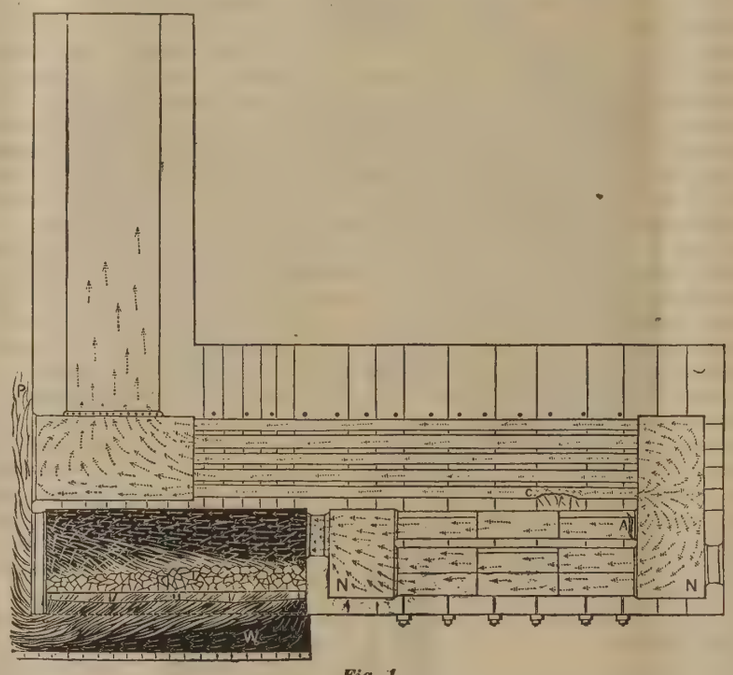


Fig. 1.

An inspection of the port boiler showed it had not given out, though many serious defects were discovered, due to its age and long service; the starboard boiler was found in a much worse condition, the crown sheets in both furnaces were badly bulged in several places. In the back connection a serious crack, some 15 inches long, shown at A, Figs. 1 and 4, was found in the upper right-hand wing flue; this crack was open ¼ inch wide. The left-hand flue (see Fig. 4) was cracked in the same place, though not so badly. These flues were 10 inches in diameter. The cracks were within 2 inches of their ends, following the lap of the flange where the flues were riveted to the head. The flues were no doubt weakened by the fretting of the seams at that point, assisted by the corrosion that had reduced the iron in places. A piece of the iron cut out indicated that it was very brittle. The rivet heads at the seams were so badly corroded but little of the heads remained. One of the tubes (3¼ inches diameter) in the lower row had so wasted away, that in one place it had collapsed for a distance of about 6 inches, shown at C, Fig. 1. This tube, with a piece of the tube head (see Fig. 2), had been cut out and carried away, and the location of the rupture is a matter of hearsay (see supplementary report at the end of this article). This was the condition of the boilers at the time of the visit, they had been tested by a government inspector less than three months before, by hydrostatic test of 60 pounds per square inch, and were licensed for one year thereafter at a steam pressure of 40 pounds per square inch. Before the coroner's inquest, recently held in Hartford, to determine the cause of the disaster, the United States Boiler Inspector and officers of the vessel appeared and testified as follows:

United States Inspector: "Inspected the 'Seawanhaka's' boilers in March last, and found them in very good condition; since the disaster he had examined them and found in the starboard boiler some of the tubes were cracked and probably drawn out; the top of the furnace was warped; the other boiler was all right; the stop-cock in front of the starboard boiler that is used to throw water in the front of ash-pan when it becomes too hot, was broken off; the starboard boiler was nearly empty, the other half full. After examination, he concluded the cause of the fire could not have sprung from any defect here, because an explosion would have blown the head of the boiler off; the ruptures [*Mem.*—Probably referring to cracked flues and collapsed tube], in his opinion, was caused after or during the fire. *He thought the boat took fire from some hot coals under the ash-pan.* The steamer was well supplied with boilers; if either of the boilers had burst, there would not have been steam enough to beach the boat."

The captain testified: "Between the discovery of the fire and the beaching of the boat about three minutes and fifteen seconds elapsed; the ash-pan is made of boiler iron, and is usually kept full of water; under the ash-pan was a layer of fire-brick and cement [*Mem.*—See Fig. 1, W]; *did not think the fire could have originated there;* had no opinion of where it could have started."

Fig. 3.

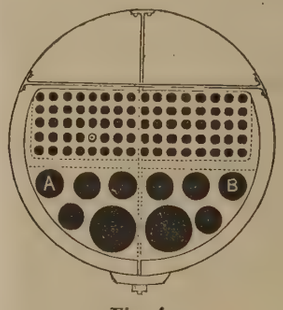


Fig. 4.

The engineer testified: "I first heard a dull, rumbling noise, and stepped into the fire-room and turned off the jet. I started to go below, *but was met by a sheet of flame starting from under the starboard boiler;* opened the jet again to make the flame take its proper course; it had no effect; tried to start the donkey pump, but was compelled to abandon it on account of the flame and smoke; in my opinion the fire was caused by the back draft from the starboard boiler; do not know what

caused that; *might have been caused by the explosion of a flue.* I had about 33 pounds of steam at the time. We used egg size coal. The fireman swore there was plenty of water in the ash-pan at the time."

The facts as narrated above, of events before and after the sudden appearance of the flame, are not accounted for on the supposition that the boat took fire from the coals in the ash-pan. Many fires have occurred from that cause. But they burned with far less intensity, and with the appliances usually provided for putting out fires, were speedily under control. In the lightning-like rapidity with which the fire-room was filled with flame and gas after the explosion and jar felt by many of those on board, we have an extraordinary effect, and must look about the boilers for a cause sufficient to have produced it; that we find in the collapsed tube and ruptured flues in the back connection of the starboard boiler. Probably the fires forced by the steam jet were strong and heavy, say 10 to 12 inches deep upon the grates. The collapsing of the flue, if as badly as has been described, would have choked up the front connection, backed up the draft, and driven the flame out from under the grates and through the other openings in the front of the boiler in quantity sufficient to have caused the destruction that resulted.

It is proper in reply to those who say the boiler could not have exploded or ruptured—for that would have released the steam, and the engine would have stopped—to remind them that there were *two boilers*, while but one (the starboard boiler) ruptured, and the time that elapsed from the explosion to the beaching of the steamer, as sworn to by captain and mate, was between three and four minutes, and the port boiler would have kept up a supply of steam for that length of time. It is impossible to say whether the flues ruptured at the same time that the tube collapsed, for too long a time had elapsed between the disaster and the time of the examination of the fractured parts, to be positive. The flues had been patched a number of times. Boiler explosions occasion more or less destruction, according to the circumstances. The rupture of a flue near its mouth, where it is stiffened by the roundabout seam, as well as the flanging of the head, would be likely to do less damage than if it occurred at some point midway of its length, where it is weaker. A number of cases in point could be named to prove this fact.

Herewith is appended the verdict of the coroner's jury: "We find that H. B. DeBevois, and thirty-four others, came to their death by injuries, the result of a fire which occurred on board the steamer 'Seawanhaka,' on the 28th day of June, 1880, on its passage from New York to Roslyn, L. I., and that said disaster was caused by the bursting or collapsing of one of the tubes in the starboard boiler, whereby the flames were driven under the grate bars into the fire-room, thereby igniting the wood-work, causing the destruction of the boat. We further find that the boiler had been duly inspected by the United States government inspector in March last, and that the said boat was provided with all the appurtenances required by law; and the jury further believe that the loss of life in this disaster would not have been so great had the crew been disciplined and exercised to act in concert in case of a panic through fire or other cause. In conclusion, the jury would strongly recommend, to avoid a recurrence of a similar disaster, that the ceilings and walls, as well as the floors, of the fire-rooms of all steamboats should be incased in metal, at a suitable distance from the woodwork."

SUPPLEMENTARY REPORT MADE FROM LATER INFORMATION.

Since the above examination was made, an interview has been had with the boiler-maker who cut out the ruptured tube soon after the accident. The information thus obtained, condensed somewhat, is substantially as follows: On attempting to pass an old steam pipe, used as a probe, through the tubes, it met an obstruction in the ruptured one, which was thereupon cut out, a piece of the tube plate shown in Fig. 2 being cut away so that the tube could be taken out without violently driving it through the original opening in which it was "set" in the plate, the effect of which would be to distort or break it.

At the interview, the gentlemanly proprietor minutely described the tube, but firmly declined to exhibit it to the company's representative, or to any one else. The cut, Fig. 3, was made from his description, and is a vertical section through the tube, showing about half of the ruptured part, which he says was located about 2 to 3 feet from the front end. The cut, Fig. 1, shows it as located about that distance from the *forward* (in distinction from the *after*) end, as it was understood when that cut was made. The difference of location is obviously of little importance in explaining the accident. The present condition of the tube, as described, warrants the conclusion that a flap was turned inward, hinging on the front part of the opening, so as to obstruct the passage of the water and steam in that direction and cause it to flow, as indicated by the arrow, toward the back smoke chamber, reversing the current of hot gases—that is, causing back-draft. After a time the flap became detached at the line *a*, Fig. 3, and was blown away, or perhaps it might have been broken off by the boiler-maker's probe, leaving the opening as though the dotted line *a* were its boundary. The missing piece may have been detached at once and jammed in the tube, producing the same effect. However this may be, there was undoubtedly a rapid escape of the water, charged with steam, which was instantly freed from the water when it impinged on the vertical surface of the back smoke connection, the water falling while the steam escaped both ways in such quantity as to make say one-16th of a pound pressure per square inch in the smoke passages. This pressure, which would not show on an ordinary steam gauge, would amount to about 1½ inches of water column, which is a greater pressure than would be balanced by the draft of the highest chimney, and would be quite sufficient to transform the boiler furnace into an immense blow-pipe, as the steam would be practically dry after passing both chambers and impinging upon two vertical surfaces before reaching the heavy bed of incandescent coal in the furnaces, while the lower flues and the lower part of the chambers afforded ample room for the storage of the water from which the steam escaped.

As to the relative time when the two 10-inch flues gave way, it appeared, on subsequent examination by a representative of the company, that the shell of the boiler had been sufficiently heated to soften it, which, judging from the corrugated appearance, must have been after the pressure had subsided within the boiler, and the condition of the ruptured edges indicates that they yielded to a tensional strain which it is probable was caused by the extra expansion of the shell to which the two flues A and B were more rigidly attached, being nearer the flange than the central ones which did not break. After the water had fallen below the ruptures in the starboard boiler, the blowing of the fire was no doubt kept up by steam escaping from the remaining water, heated by its own blast upon the bed of coals and communicating its heat to the sides, which were still covered with water, and to the crown of the furnace, which was uncovered and became overheated and bulged, as described in the foregoing report.

PROFESSOR MAYER'S TOPOPHONE.

The Topophone, or Sound-Placer.

One of the most ingenious of recent applications of science to practice, is illustrated in the invention which is described herewith, and which originated with Prof. A. M. Mayer, of Hoboken, N. J., one of the ablest and most original investigators in the ranks of American physicists.

The purpose of the invention is to enable a person to locate with exactness the direction of a sound; from which it will appear that it may prove of great benefit to mariners in navigating in thick or foggy weather, since it is notorious that the location of sound under such circumstances is very uncertain. The unusual frequency during the past few months of collisions and other accidents, attributable almost entirely to the want of adequate provisions to enable navigation in dark or foggy weather to be safely executed, has called forth on all sides protests against the inefficiency of present methods, and demands that such improved methods and facilities as have been demonstrated to be practicable and meritorious should be adopted. We have had occasion in the columns of this journal to condemn the lamentably insufficient methods yet in vogue, and to urge the adoption of the electric system of lighting as the one which should be universally introduced on shipboard, in place of the utterly inadequate oil lanterns in use, as a means of penetrating the blackest night and the thickest fog, and thus indicating her course to other vessels at a sufficient distance to enable them to give her a wide berth. In our September issue we commended the idea of Capt. Bridge, who has proposed a simple and efficient system of sound signals by whistle or fog horn, by which passing vessels may signal their course, exchange messages and the like; and we have now the opportunity of recommending for adoption on shipboard another admirable safeguard against accidents at sea—the topophone of Prof. Mayer, the use of which enables the mariner to determine with promptness and accuracy the direction of unseen sources of sound.

We have already described the essential features of this ingenious apparatus (see our April number), but the accompanying illustration will render its construction and action much more intelligible. The form of the apparatus shown in the engraving is the portable one, while for most cases it would be a fixture in the pilot-house or on the bridge. In either case the action is the same; and this is based on the principle in acoustics that two sounds of the same intensity and pitch may, under suitable circumstances, be made either

to strengthen each other or to obliterate each other. How this principle is applied will appear from the following description of the apparatus: It consists of two sound receivers attached to a yoke or shoulder piece. These receivers are connected by means of flexible tubes, which unite for a portion of their length in a single tube, from which a flexible tube proceeds to each ear. One of these tubes, that on the right-hand side, it will be observed, is made telescopic, so that it may be lengthened or shortened. When the sound-receivers are both turned in the direction from which a sound is proceeding, they will both be brought simultaneously on the wave surface, and they will both receive at the same instant the same phase of vibration on the planes of their mouths. The result will be that, if the connecting tubes are of equal length, the sound pulses, acting together, will reinforce each other and the sound will be augmented; but if the connecting tubes differ in length (the resonators being retained in the same position as regards the sound as before) by one-half the wave-length of the sound, the pulses of the one will oppose and neutralize those of the other, and the result will be the obliteration of the sound, and consequently silence. In the first case each sound rarifies or condenses the air at the same instant of time with the other, therefore the degree of rarification or condensation is increased, and the sound is louder; in the second case, the sound wave entering one receiver, is condensing the air in its tube at the same instant that the wave entering the other is rarifying it, and the result, in the single tube where the two unite, is that of two actions equal and opposite—the air is neither rarified nor condensed, and the sound is obliterated.

In using this instrument, the observer, guided by the varying intensity of the sound in the resonators, turns until the openings of both touch the same sound waves, which he recognizes by the decided strengthening of the sound. He is then facing the direction from which the sound proceeds. To control this determination, he may vary the length of his telescopic tube as described, and produce interference and silence. In either case, the location of the direction of the sound, with the aid of the instrument, is unerring and instantaneous. Where the instrument is a fixture on the bridge or in the pilot-house, some slight modifications in details of construction are introduced, but the essential features shown in the apparatus here illustrated and described are retained.

It will be obvious to our intelligent readers that this instrument will enable the navigator or pilot not only to determine the direction of a sound or signal, but also to determine approximately the distance of the sounding body. Suppose, for example, that the direction of the sound has been ascertained, which would be a straight line drawn from the place where the sound is produced through the place of observation. This direction with reference to the ship's course is therefore ascertained. By sailing the ship for a measured distance in the same direction, a second observation of the direction of the sound will give as known factors two angles and a side of a triangle, from which the calculation of the length of one of the other sides, which is one of the lines from the ship to the position of the sounding body, can be readily made.

The utility of this beautiful instrument is obvious, and has been amply demonstrated by repeated trial tests by members of the Light-House Board.

Scientific.

The Sun Engine.—The problem of constructing an engine by which the heat of the sun could be directly utilized for the production of mechanical effect, has for some time engaged the attention of scientific men. The idea is not, as might be supposed, confined to impracticable theorists, but is seriously entertained by men eminent for their practical qualities.

To give a general view of the subject, we present herewith a brief statement of the scientific features of the problem which will serve to show the possibilities of the case. It has been fully demonstrated that every exhibition of terrestrial activity has its origin in the forces of solar radiation. Every manifestation of force, physical or chemical; the multifarious consequences connected with the circulation of air and water over the earth's surface, and the effects of these commonplace but highly important phenomena in establishing and maintaining the climatic conditions on which the existence of life on our planet are entirely dependent, are directly traceable to the forces of solar radiation; and to convey some idea of the immeasurable floods of energy that the sun is constantly sending out into space, it must be borne in mind that the prodigious aggregate of terrestrial activity is derived from that infinitessimal fraction of the solar emanations that reaches the earth—and this fraction is less than the two-billionth part of the sum total of the solar energy that is unceasingly being radiated into space.

The French physicist, Pouillet, who has given much study to the question of the amount of power that the earth receives from the sun, has calculated from experimental data that our planet receives from the central orb in each and every minute 2,247 billion units of heat—a quantity sufficient, if converted into mechanical force, to raise 1,739 trillion pounds to the hight of one foot. The amount of solar heat expended in evaporating water from the surface of our oceans, suffices to raise every minute the enormous quantity of two billion tons of water to the mean hight of the clouds, or 3½ miles—an expenditure of force that would be the equivalent of 2,757 billion horse-power per minute. With such evidences of immeasurable force at hand, it is not strange that thoughtful men have set themselves to work to discover if some of it could not be converted into mechanical energy in such a manner as to be made more directly available for useful purposes. Hence the idea of the solar engine.

Ericsson, who has devoted much attention to this subject, has given it as his decided opinion that the sun engine is practicable. He has progressed so far with the problem as to have announced the general principles on which he proposes to construct such a motor, and has actually constructed working engines in accordance with these principles. The Ericsson solar engine consists essentially of three parts—the engine proper (that is, the working mechanism), the steam generator, and the concentrating apparatus, by means of which last the feeble intensity of the sun's rays is augmented sufficiently to produce steam at a practicable working pressure. He claims that his concentrating apparatus will abstract, on the average, for all latitudes between 45° N. and 45° S., fully 3½ heat units for every square foot presented vertically to the sun's rays. With 100 square feet of surface in his concentrating apparatus, therefore, he believes it will be possible to continuously develop from the sun's rays 8.2 horse-power during nine hours within the above named range of latitude.

In considering the practical side of the subject, Capt. Ericsson assumes that the sun engine will have only one-eighth of this capacity—that is to say, that to generate one horse-power, the engine will demand the concentration of solar heat from 100 square feet. On this greatly reduced estimate, he proceeds to argue that in all reasonable probability those regions of the earth that now suffer from an excess of solar heat, will some day in the future derive such benefit from their unlimited command of motive power as to greatly overbalance their climatic disadvantages.

He proposes the sun engine only for those regions where there is steady sunshine, and has mapped out extensive tracts of land aggregating no less than 9,000 miles in length and 1,000 in breadth, as the field of the solar empire of the future. In this region are included the southern coast of the Mediterranean, Upper Egypt, much of the Red Sea region, the greater part of Persia and Arabia, and portions of China, Thibet and Mongolia in the eastern hemisphere; and Lower Calfornia, the Mexican plateau, Guatemala, and the west coast of South America for a distance of 2,000 miles in the western hemisphere.

To show the sincerity of his belief in the practical realization of these ideas, we append one of his characteristic utterances. "The time will come," he says, "when Europe must stop her mills and factories for want of coal; Upper Egypt then, with her never-ceasing sun power, will invite the European manufacturer to remove his machinery and erect his mills on the firm ground along the sides of the alluvial plain of the Nile, where sufficient power can be obtained to enable him to run more spindles than a hundred Manchesters." And again: "The time will come when the Nile and the Ganges will be lined with cotton and other factories driven by solar heat; and the raw material being at hand, labor plentiful, and the motive power inexpensive, these regions will defy all foreign competition."

It may be remarked in conclusion, that Ericsson is not alone in his advocacy of this novel departure. Several eminent savants have of late been prominently identified with the subject of developing the idea of the solar engine into utility. Of these, perhaps the best known is Mouchot, a Frenchman, who exhibited a working engine of this type at the late Paris Exhibition, which attracted great attention and a flattering report from the Committee of Judges. He has since been carrying on experiments with the view of perfecting the apparatus in Algiers, and has succeeded, with a sun engine, in pumping water, distilling alcohol, and performing other useful work. The principles of the apparatus of Mouchot seem to be substantially the same as those enunciated by Ericsson, the pioneer in this field of investigation.

Drying Up.—Few, if any, of our readers would have suspected the fact, but it is nevertheless probable, that the earth is gradually losing her superficial water, or, in other words, is drying up. This inference, which seems to be well substantiated, has been drawn by many geologists, who have given special study to the metamorphoses which the rocks composing the earth's crust have undergone in the past, and are now undergoing.

It is generally assumed that the evaporation of the water from the surfaces of our oceans, lakes and rivers is balanced by the amount of the various forms of aqueous precipitation—rain, snow, hail, etc.—from the clouds, by which the water finds its way back again to the earth. This is strictly true in the sense that not a particle of water passes beyond the limits of our atmosphere, and that all that finds its way into the atmosphere by evaporation, sooner or later is returned again. Nevertheless, the water supply of the earth is slowly but steadily diminishing. It is not destroyed, but is so modified as to be no longer available for the sustenance of animal and vegetable life, since it is absorbed and bound up in the rocks. This disappearance of water is accounted for partly by mechanical absorption; partly by the chemical union of water with the constituents of certain of the rocks, called hydration, and which is one of the phenomena generally attending the superficial weathering of the rocks; and partly by the crystallization and re-crystallization of many of the constituents of the rocks, and other extensive chemical changes going on at unknown depths in the bowels of the earth. In the course of time, though necessarily many ages from the present, it is argued, the combined result of these several causes of dessication must be the complete absorption of all the water, and its disappearance from the surface of the earth.

The estimate has been made, though such an estimate can be little more than a guess, that one-seventeenth of the quantity of water with which the earth was originally provided, has already been bound up chemically in the rocks, or has been absorbed beyond the possible reach of the organisms living upon her surface.

New Uses for Rock Crystal.—A German maker of philosophical apparatus, Herr Siegfried Stein, of Bonn, has of late strongly urged the claims of rock crystal as a material pre-eminently adapted for the production of

normal weights and measures, and other instruments of precision. He has made sets of weights, balance beams and scale pans of balances, and portions of engineering instruments, from rock crystal, and his innovation has received many favorable comments from professional men.

The advantages of rock crystal over metals for such instruments of precision, consist in its complete indifference at common temperatures to the action of acids or alkalies, and to the gases and moisture present in the atmosphere, which to a greater or lesser degree must in time affect the last named. For the production of standard weights especially, Herr Stein's suggestion has been received with great favor, his rock crystal weights having obtained the unqualified praise of such eminent analysts as Fresenius and others. For this particular use, it may be added, its superior hardness to the metals usually employed is another decided advantage.

In presenting the merits of his suggestion to employ this material for the above purposes, before a late session of the German Chemical Society, he remarked very properly, that in order to weigh accurately, it was not only necessary to have unalterable weights, but also an unalterable balance. The main parts of a balance are the beam and the scale pans, all of which should be practically unalterable and as light as possible. He strongly advocated the use of rock crystal for those parts of balances, because of its practically perfect indifference to atmospheric and other influences, in which quality it surpasses any of the metals; because of its lightness, in which respect it rivals aluminum (specific gravity, quartz=2.65; specific gravity, aluminum=2.61); and, in addition, because it is highly inelastic and inexpansible. Herr Stein urged, on similar grounds, the advantages of rock crystal in the production of standards of measure, whether longitudinal or circular, and in the construction of parts of a number of instruments of precision.

A New Astronomical Discovery.—A highly important discovery is credited to Prof. E. C. Pickering, Director of the Harvard Observatory, which one of the leading journals holds to be "one of the most important of the century in stellar physics."

The account given of this discovery is substantially as follows: In the ordinary telescope, a star appears as a point of light, brighter, but not larger than when looked at with the naked eye. Prof. Pickering modifies the usual method of telescopic observation by placing a prism between the object glass and the eye-piece of his instrument. Through this combination the light of a star appears to be drawn out into a continuous band. When the instrument so arranged, however, is turned upon one of the planetary nebula, the light therefrom appears to be collected into a star-like point, without any band.

The importance of this observation will be manifest, since it enables the astronomer to distinguish at once without difficulty between a star and a planetary nebula. Prof. Pickering is reported to have already made excellent use of this method, by discovering several new nebulæ. On August 26th, he is said to have made a very anomalous observation, the object in question having the appearance of two star-like points within the band in his modified telescope. This appearance is different from anything heretofore observed, and Prof. Pickering is giving the object in question his careful study.

Reducing Power of Magnesium.—The powerful reducing action of magnesium can be shown by plunging an ignited strip of magnesium wire into a glass vessel filled with carbonic acid gas. In this atmosphere, which is usually a non-supporter of combustion, the magnesium wire will continue to burn with its characteristic white light, throwing out brilliant sparks in all directions. Flakes of black carbon soon begin to be deposited on the walls of the vessel, while the white magnesia resulting from the combustion settles to the bottom. The reaction can be made to form a brilliant and instructive lecture experiment. The reduction of carbonic acid gas by means of metallic sodium or potassium, by passing the gas through a heated tube containing a fragment of one of these metals, is no doubt familiar to most of our readers, but the phenomenon is by no means so striking as when presented in the manner above described.

Copper in Plants.—It has generally been held that metallic substances impregnating the soil were not absorbed by plants; that the roots possessed a species of selective power in virtue of which they rejected everything of an injurious nature. This is not strictly true, since there are exceptions to the rule. The ashes of a species of violet (*Viola calaminaria*), which flourishes on the waste ore heaps of certain of the zinc mines of Rhein Prussia, have been found to contain considerable quantities of zinc. M. Dieulafait, a noted French mineralogist, now adds his testimony to the inaccuracy of this opinion, by proving the presence of copper in plants which grow on rocks belonging to the copper-bearing series. In some instances he was able to obtain a distinct reaction for copper with ammonia in one grain of ash. It is not improbable that investigation would disclose the fact that other metals are also taken up by plants.

Lubricating Qualities of Plumbago.—As an evidence of the eminent lubricating qualities of this material, the statement is made, apparently on good authority, that a planing table at the Stevens Institute, which had been lubricated with sperm oil, required then the united force of eight men to move it. When the same table was lubricated with plumbago, it could be moved with ease by one man, using only one hand.

Celluloid Printing Plates are now made, if report is to be credited, as a substitute for electrotypes and stereotypes. The accounts given of these *clichés* affirm that they make wonderfully fine reproductions of the original, and that they have greatly superior wearing qualities in the press.

Transmitting Sound Along a Beam of Light.

Although, as we remarked in our previous issue, the papers read before the American Association for the Advancement of Science, this year, were characterized by the variety and number of the subjects discussed, rather than by their novelty, the meeting was treated to at least one genuine surprise by the presentation of the results of some most remarkable observations and experiments made by Messrs. Alexander G. Bell and Sumner Taintor. These gentlemen, the first named of whom is widely known as the inventor of the telephone that bears his name, have struck out in a highly original line of research, and have so far succeeded in their work that they have put their ideas into practical shape. The problem which they have successfully grappled with, is the surprising one of producing and reproducing sounds by means of light.

In describing their experiments to the association, Mr. Bell stated that they had been led to the idea that the audible effects of the telephone, which are produced by the modification of the electrical current by sound waves, might be produced by variations in the intensity of light acting on selenium, and that by constructing suitable transmitting and receiving apparatus, it might be possible to produce audible effects at a distance without the use of a connecting wire.

This ingenious piece of reasoning they at once proceeded to test in practice. They employed for their purpose a flexible mirror of silvered mica, against the back of which the speaker's voice is directed. The light undulations reflected from this mirror, according to theory, should be modified according to the nature of the sounds. The experimenters employed a concentrated beam of sunlight, which, after reflection from the vibrating mirror, was received upon a parabolic mirror located at the receiving station, in the focus of which was placed a selenium cell connected in a local circuit with a battery and telephone. With this simple apparatus these gentlemen have succeeded in actually demonstrating the practicability of their theory by transmitting and reproducing, at a distance of 800 feet, audible messages along a beam of light.

The possibility of transmitting sounds by means of light having thus been practically demonstrated, the question of the distance over which such communication can be carried, need hardly be considered in this place since it will obviously depend simply on the perfection of the details of the apparatus which will follow as a matter of course. In view of what has been accomplished, we may even assert with safety that the only limitation upon the range of the photophone, as the inventors call their apparatus, will be the distance to which a beam of light may be sent with certainty from one station to another; and, as most of our readers are aware, this has been accomplished by means of the heliograph between elevated stations nearly 50 miles apart.

One very interesting and valuable contribution to science which has come from the experiments of Messrs. Gray and Taintor, is the discovery of the fact that selenium is not the only substance that is sensitive to light. On this point Mr. Gray remarked that "the final result of our researches has widened the class of substances sensitive to light vibrations, until we can propound the fact of such sensitiveness being a general property of all matter. We have found this property in gold, silver, platinum, iron, steel, brass, copper, zinc, lead, antimony, German silver, Jenkins' metal, Babbitt's metal, ivory, celluloid, gutta-percha, hard rubber, paper, parchment, wood, mica, and silvered glass; and the only substances which gave us negative results are carbon and thin microscopic glass. We find that when a vibratory beam of light falls upon these substances, they emit sounds, the pitch of which depends upon the frequency of the vibratory change in the light. We find, further, that when we control the form or character of light vibrations on selenium, and probably on the other substances, we control the quality of the sound and obtain all varieties of articulate speech. We can thus, without a conducting wire, as in electric telephony, speak from station to station wherever we can project a beam of light.

"We have not had an opportunity of testing the limit to which this photophonic influence can be extended, but we have spoken about 800 feet apart, and there seems no reason to doubt that the results will be obtained at whatever distance a beam of light can be flashed from one observatory to another. The necessary privacy of our experiments hitherto has prevented an attempt at determining the extreme distance at which this new method of vocal communication will be available."

It is impossible at the present time to estimate the practical value of these beautiful scientific discoveries. From the nature of the case, the photophone cannot take the place of the telephone, save to a limited extent, since the use of the new instrument requires that there shall be no interposed obstacles in the path of the beam of light from station to station. Those, therefore, who are interested financially or otherwise in the telephone, have nothing to fear from the development of the photophone. But it is safe to affirm that the new method of vocal communication along a beam of light will in time revolutionize the art of signalling for military and engineering purposes. But aside from the question of utility, we cannot refrain from expressing our admiration at the highly original discoveries of Messrs. Gray and Taintor, which will rank in future among the most beautiful and novel in the history of science.

Test Paper.—A useful test-paper can be made by boiling one pound of leaves of red cabbage in one pint of water for some time, and then straining the blue liquor through muslin. Evaporate to about half its bulk; place layers of white blotting-paper in the liquid, and then hang them up to dry. Acids change the blue color of the paper to red, and alkalies turn it green. This is a good substitute for litmus paper.

The Warner Observatory at Rochester.

At a time when the remarkable material development of this country is attracting universal attention, it is a cause for congratulation that its literary and scientific institutions are keeping pace with its material growth. Among the latest acquisitions to promote the cause of scientific research, and which we deem to be of signal importance, is the erection of the new astronomical observatory at Rochester, N. Y. Prof. Swift, who has become known throughout the world as the fortunate discoverer of a number of comets, has labored heretofore under many disadvantages in his work, owing to a lack of proper facilities. The new observatory will entirely overcome these troubles, as the telescope which is to be mounted in its dome will rank as the third in magnitude in America.

But however valuable all future discoveries may be, the astronomers of this country have no cause to be ashamed of their record in comparison with that of the savants of the old world. Prof. Hall, of the Washington observatory, has placed to his credit the brilliant discovery of the two moons which accompany Mars, which is worthy to rank among the great astronomical discoveries of the present century. Prof. Bond discovered the eighth satellite of Saturn in 1848, and the transparent ring of the same planet in 1850. The separation of Biella's comet into two parts was first observed by American astronomers, and the observations of Profs. Watson and Swift during the solar eclipse of 1878, have probably added three intra-Mercurial planets to the list of those previously known.

In addition to these notable discoveries, the astronomers of the United States lay claim to the honor of finding more than a thousand double and triple stars (many of these being the largest of this class of bodies), over fifty asteroids, and fifteen new comets. When it is remembered that the most of this work was done with inferior instruments, and in a country where storms and clouds are so prevalent, the diligence and perseverance of American astronomers cannot be too highly praised.

The new observatory at Rochester, an illustration of which we give on this page, is to be devoted primarily to discovery. Its arrangement and facilities are specially designed for this purpose, and we expect to hear an excellent account rendered of its service to science during the years to come. It is named the Warner Observatory, in honor of Mr. H. H. Warner, a gentleman of wealth and a generous patron of science, by whom it has been most liberally endowed. Its location is one of the most commanding in Rochester. The new telescope will be 22 feet in length, with an object glass of 16 inches clear aperture, and the dome of the tower will be provided with the latest appliances for sweeping the heavens in every direction.

THE WARNER OBSERVATORY AT ROCHESTER, N. Y.

Cryolite and its Uses.

The mineral known by this name has figured in descriptive works on mineralogy for many years, but until lately it was known to mineralogists only as a rare and curious mineral of no value in the arts. It has been found at Miask, in the Ural Mountains, in limited quantities; but the great source of its occurrence is the west coast of Greenland, where it is found in immense quantities. The particular locality of this occurrence is Ivigtout, on the Arsuk Fiord, between Julian's Hope and Fredericks. According to report, the main deposit here forms a mass 600 feet in length, 200 feet in width, and of unknown thickness.

The mineral is quite characteristic and beautiful. It is partially translucent, and generally occurs in crystalline, cleavable masses of a snowy white color, having very much the appearance of snow-ice, whence its name (from the Greek *Kryos*—ice). It is frequently associated with galena, blende, pyrites (both iron and copper), and spathic iron ore.

The chemical constitution of the mineral—fluoride of sodium and aluminum—is so peculiar as to have attracted the attention of chemists to it as long ago as 1850, as a possible profitable source of soda; and in that year, a well-known Danish chemist, Julius Thomsen, discovered a cheap method of rendering cryolite available for the manufacture of soda and alum. Since that time the cryolite industry has grown to such proportions that many thousands of tons are annually shipped and consumed. In this country the Pennsylvania Salt Manufacturing Company, at Natrona, Pa., have a large manufactory, at which great quantities of cryolite products are annually manufactured.

The utilization of cryolite is based upon Thomsen's observation that the mineral may be completely decomposed by treatment with lime, either in the wet or dry way, the products of this treatment being, generally speaking, caustic soda, aluminate of soda, and fluoride of calcium. The ease with which this decomposition can be effected, and the considerable percentage (32.8 p.c.) of sodium which the mineral contains, renders it a very valuable source of soda and its compounds. The alumina which the mineral contains is likewise utilized for the production of alum and alumina salts. The method of operation is substantially as follows: Where the dry process is used, the cryolite is dried, ground to a fine powder, and mixed with slaked lime or pulverized chalk, in such proportions that for each equivalent of cryolite there shall be about six of lime. This mixture is then calcined in a furnace at a dull red heat, not sufficient however to fuse it. After a charge has cooled, it is lixiviated, and the dissolved soda and aluminate of soda are drawn off from the insoluble residue—fluoride of calcium. Carbonic acid gas is then passed through this solution, by which the soda is converted to a carbonate, and the alumina is precipitated.

Where the wet process is used, the powdered cryolite is boiled with milk of lime, and, according to the proportions of lime employed, the resulting products are caustic soda and aluminate of soda; or, where an excess of lime has been used, caustic soda and aluminate of lime, fluoride of calcium being formed in both cases.

The last named procedure, it will be noticed, gives all the soda of the cryolite in the caustic state, the only operation required to obtain it being evaporation to dryness. In this manner, we are informed, large quantities of soda lye are produced at the Natrona works, above named. This operation is extremely simple, and the freedom of the crude material from injurious impurities, which is insured by careful selection, renders the products obtained from cryolite very valuable.

The aluminate of soda produced in the operation above described, is said to be largely used in the manufacture of soaps, in place of soda and potash lye. It is completely decomposed by passing carbonic acid gas through it, and the precipitated alumina may be converted either into sulphate of alumina or alum.

We are informed that the fluoride of calcium, which is a by-product of the treatment of cryolite, is utilized to a considerable extent by glass manufacturers, and it could doubtless be used as a flux in many metallurgical operations.

When finely pulverized and mixed with sand, in the proportions of one of cryolite to three or four of sand, cryolite has been successfully employed in the production of a beautiful white glass or porcelain ware, which is readily molded or cut, and which is remarkable for its tenacity.

The supply of this interesting mineral appears to be practically unlimited, thus assuring the future of the great industries that it has created. The present annual value of cryolite products is not less than several millions of dollars.

The French Government has extended for three years the concession for the preliminary work on the proposed Channel tunnel to connect England and France. The original concession was made in 1875, for five years. So far all the geological evidence, and especially that derived from the experimental borings, has proved to be highly satisfactory. It is questionable, however, whether in the event of a favorable termination of the preliminary work, it would actually be undertaken exclusively by private enterprise, by reason of its enormous costliness. In such an event, doubtless the two governments interested in its execution, will be asked for, and will grant the enterprise, substantial assistance.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

LUMBER.

Pine, very choice and extra dry, per M	$60 00 a 70 00
Pine, good	55 00 a 60 00
Pine, shipping box	20 00 a 22 00
Pine, common box	17 00 a 18 00
Pine, common box, ⅝	15 00 a 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	42 a — 48
Pine, tally plank, 1¼, 2d quality	35 a 38
Pine, tally plank, 1¼, culls	28 a 30
Pine, tally boards, dressed, good	28 a 30
Pine, tally boards, dressed, common	25 a 28
Pine, tally boards, culls, dressed	22 a 25
Pine, strip boards, merchantable	16 a 18
Pine, strip boards, clear	22 a 25
Pine, strip plank, dressed, clear	33 a 35
Spruce boards, dressed	20 a 22
Spruce plank, 1¼-inch, dressed	25 a 28
Spruce plank, 2-inch	40 a — —
Spruce wall strips	14 a — 15
Spruce timber, per M	20 00 a 25 00
Hemlock boards, per M	16 00 a 18 00
Hemlock joist, 2½x4, each	15 a — 16
Hemlock joist, 3x4	16 a — 18
Hemlock joist, 4x6	40 a — 44
Ash, good, per M	50 00 a — —
Oak	55 00 a 60 00
Maple culls	25 00 a 30 00
Maple good	45 00 a 50 00
Chestnut	45 00 a 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 a 40 00
Black walnut, good to choice	85 00 a100 00
Black walnut, ⅝-inch	75 00 a 85 00
Black walnut, selected and seasoned	110 00 a150 00
Black walnut counters, per ft	15 a 20
Cherry, wide, per M	85 00 a100 00
Cherry, ordinary	60 00 a 80 00
White wood, inch	45 00 a 50 00
White wood, ⅝-inch	30 00 a 35 00
White wood, ⅝ panels	35 00 a 40 00
Shingles, extra sawed pine, 18-inch	4 00 a 5 00
Shingles, clear sawed pine, 16-inch	3 75 a 4 00
Shingles, cypress, 24x6	18 00 a 20 00
Shingles, cypress, 20x6	10 00 a 12 00
Lath, Cargo rate	1 85 a — —
Yellow dressed pine flooring	30 00 a 37 50
Yellow pine girders	32 50 a 40 00
Locust posts, 8 feet, per inch	18 a 20
Locust posts, 10 feet	24 a 25
Locust posts, 12 feet	29 a 34
Chestnut posts, per ft	3 a 3½
Basswood per M	25 00 a 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	3 12½ a	3 50
Up Rivers	5 37½ a	5 62½
Jersey	— — a —	—
Long Island	— — a —	—
Haverstraw Bay	5 62½ a	5 75
" " choice	5 87½ a	6 00
Favorite Brands	6 25 a	6 50
Hollow Fire-Clay Brick	9 00 a	9 25

FRONTS.

Croton—Brown, per M.	10 00 a 11 00
" Dark	11 00 a 12 00
" Red	11 00 a 12 00
Philadelphia	— — a — —
Trenton	21 00 a 22 00
Baltimore	38 00 a — —
Clark's Glens Falls, White	23 00 a — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	23 00 a 23 50
" Glengarnock	22 00 a 23 00
" Eglinton	21 00 a 21 25
" American, No. 1	24 50 a 26 00
" American, No. 2	21 00 a 22 00
" American, forge	19 00 a 20 00

	Store prices.	Cash.
Bar, Swedes, ordinary sizes	— 6 a	— 6¼
Bar, Swedes, nail-rod	— 6½ a	— —

LEAD—PER 100 POUNDS.

*German	— — a — —
*English, common	— — a — —
*Spanish	5 75 a — —
*Foreign, refined	— — a — —
*Bar	6 50 a — —
*Sheet	7 50 a — —
*Pipe	— — a — —
*Domestic	4 63 a — —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 00 a 3 10
8d and 9d, common	3 25 a 3 35
6d and 7d, common	3 50 a 3 60
4d and 5d, common	3 75 a 3 85
3d and 4d, light	4 50 a 4 60
3d, fine	5 25 a 5 35
2d, fine	5 25 a 5 35
Cut spikes, all sizes	3 25 a 3 35
Clinch nails, 1½ to 1¾ inch	5 25 a 5 65
do. 2 to 2¼ inch	5 00 a 5 35
do. 2½ to 2¾ inch	4 75 a 4 85
do. 3 inch and longer	4 50 a 4 60

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	6 50 a 6 62
*I. C. coke, 10x14	5 00 a — —
*I. X. charcoal, 10x14	8 50 a 8 62
*I. C. charcoal, 14x20	6 50 a 6 75
*I. X. charcoal, 14x20	8 50 a 8 75
*I. C. coke, 14x20	5 00 a — —
*I. C. coke, terne, 14x20	5 25 a 5 37
*I. C. charcoal, terne, 14x20	5 50 a 5 75

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 7⅝ a — 7¾
Sheet, (open)	— 8 a — 8½

SOLDERS.

No. 1	— 12½ a — 13
No. 2	— 11 a — 12

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 a 1 00
Berlin Freestone, in rough	— 75 a — 80
Berea Freestone, in rough	— 75 a 1 00
Brown-Stone, Portland, Conn	1 30 a 1 35
Brown Stone, Belleville, N. J	1 00 a 1 35
Granite, rough	— 60 a 1 25
Canaan Marble	1 25 a 1 50
Dorchester, N.B., Stone, rough, per foot	— — a 1 00

PAINTS.

*Carmine, American, per lb. gold	6 00 a 6 25
Chalk, per 100 lbs	— 35 a — —
China Clay, per ton gold	18 00 a 20 00
Chrome yellow, dry, per pound	— 12½ a — 28
Lead, red American, per pound	— 6½ a — 7
Lead, white American, pure, in oil	— 8½ a — 9
Lead, white American, pure, dry	— 7¾ a — 8¼
Lead, white English, pure, in oil gold	— 9½ a — 10½
Litharge	— 6½ a — 7
*Ochre, Fr., dry, per 100 lbs	1 50 a — —
Ochre, ground, in oil, per lb	— 6 a — 15
Ochre, Vermont, per 100 lbs	— 75 a 1 00
*Orange Mineral, English gold	— 9½ a — 10
Paris White, American	— 1½ a — 1¾
Paris White, English, prime	— 2 a — 2¼
Paris Green	— 15 a — 28
Plumbago paint, patent, per lb	— — a — 25
Putty, per lb	— 2½ a — 3
Spanish Brown, dry, per lb	— 1⅛ a — 1¼
Spanish Brown, ground in oil, per lb	— 8 a — 9
Venetian red, per cwt	1 75 a 2 00
*Vermilion, Chinese, per lb	— 85 a — 90
*Vermilion, Trieste	— 70 a — 75
*Vermilion, quicksilver, bags gold	— 55 a —57 ½
Vermilion, American, common	— 15 a — 18
Whiting, per 100 lbs	— 60 a — 80
Zinc, white American, dry, No. 1	— 5 a — 7½
Zinc, white American, No. 1, in oil	— 8 a — 10
*Zinc, white French, dry, (Red Seal,) gold	— 8¼ a — 9
Zinc, white French, in oil gold	— 10 a — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 a 4 00
Coach Body	2 35 a 3 50
do do	1 80 a 2 00
Furniture	1 25 a 2 50
Black Asphaltum	1 00 a 1 50
Brown Japan	1 00 a 1 20
Liquid Paint Dryer	1 35 a 1 75
Harness, (black)	3 00 a 4 50
Shellac, Spirits	3 00 a 3 50

CEMENT—PER BARREL.

Portland (imported)	2 60 a 2 85
Portland (American)	2 25 a 2 50
Portland (Spanish)	2 50 a 2 75
Portland (Lafarge)	3 20 a 3 40
Portland (German, Bonner)	2 85 a 3 25
Lime of Teil	2 20 a 2 30
Lime of Teil, per ton	15 00 a 18 00
Roman	2 75 a 3 25
Keene's & Martin's, coarse	6 00 a 6 50
" fine	10 50 a — —
Rosendale	— 85 a 1 00

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb.	— 1¼ a — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16 a — 18
Goat, " "	— 21 a — 25

SLATE.

Purple roofing slate, per square	$6 00 a 6 50
Green slate	7 00 a 7 50
Red slate	10 50 a 11 00
Black slate, Pennsylvania, (at Jersey City)	3 50 a 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 a — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50 a 4 00
Nova Scotia, blue	3 50 a 3 75
Calcined, Eastern and city, per bbl	1 25 a — —
Calcined, city casting	1 50 a — —
Calcined, city superfine	1 75 a — —

LIME—PER BARREL.

State, common	— 85 a — 90
" finishing	1 00 a — —
Rockland, common, cargo rate	— 90 a — —
" finishing	1 00 a — —
Ground	— 95 a — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 a — 20
St. Domingo, crotches, fine	— 20 a — 30
St. Domingo, logs, small	— 5 a — 8
St. Domingo, logs, large	— 8½ a — 14
Frontera, Mexican, large	— 9 a — 12½
Frontera, Mexican, small	— 6 a — 8
Other Mexican	— 6 a — 12½
Honduras	— 6 a — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ a — 4½
Rio Janeiro, good to fine	— 5 a — 8
Bahia, ordinary to good	— 2½ a — 4½
Bahia, good to fine	— 5 a — 8
Honduras, per ton	10 00 a 20 00
Satin Wood, per foot	— 15 a — 25
Tulipwood, per lb	— 6 a — 7
Lignumvitæ, large, per ton	25 00 a 50 00
Lignumvitæ, other sizes	10 00 a 20 00

CEDAR.

Cuba, per superficial foot	— 8 a — 11
Mexican, small	— 8 a — 9½
Mexican, large	— 10 a — 11
Florida	— 40 a — 75

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

REVIEW OF THE MARKETS.—In the lumber market the past month buyers have been moving with caution, but notwithstanding this, they have lost no opportunity to negotiote on desirable stock, and in a quiet way a considerable amount of material has been sold. The lateness of the season admonishes dealers who have not completed their assortments, that they must do so without further delay, and there seems to be little doubt that the volume of demand can be preserved full until winter sets in with enough force to close navigation. The outlook for winter and early spring trade is good, and a revival of consumption is looked for.

In the brick market common hards have been in good demand, and the selling interest has had little cause for complaint. Prices have naturally had good support, and the tone has been very firm all around, with a slight addition to values in some cases.

In the lath market on the first of the present month matters were in a bad way. Stock had accumulated afloat to an unexpectedly large extent, buyers saw their advantage and were selfish, and for a time a heavy feeling prevailed. No sales were made public for less than $1.85, but it is very certain this was shaded in many cases. Still, by judicious management, receivers finally succeeded in placing the bulk of the supply, and the subsequent developments indicating no further important arrivals, prices once more steadied up on the above figures, and since then have been well maintained. Demand, however, has shown moderation in view of the amounts buyers have in hand against early consumption.

In the hardware market the movement of supplies has been comparatively full and general, with the market showing a cheerful tone, and dealers have been much encouraged in the belief that they will lose no ground as the season advances. The call has been from somewhat nearer points than a short time ago, but lost no volume in consequence, and has covered a full average assortment of goods. Values at the present writing cannot be called more than steady, but as a rule are held without much decline.

In the paint market trade has been without much animation, and has presented few features of an interesting character. In a wholesale way some irregularity has taken place, with, however, not many radical changes on cost made; while for jobbing parcels dealers have preserved a fairly steady tone on most of the leading descriptions of stock.

In the metal markets Scotch pig has found a moderately active demand, buyers taking only enough for early requirements; but the supply of really desirable goods offering has been moderate, with holders in most cases inclined to carry with a somewhat steadier showing. American pig has been held with a showing of considerable steadiness in many instances. The demand has shown no unusual animation, but in a quiet way there has been evidence of growing interest among buyers, and holders of desirable stock have been much less inclined to realize. Manufactured iron has been dull and prices unsettled. Domestic pig lead has found about ordinary demand, with plenty of stock offering, and holders have been as a rule willing to accept about former rates. Tin in pig has met with a good demand, in part speculative, and new strength has been infused in the market, with offerings of stock reduced. Tin plates have sold freely for future delivery, but on the spot the movement has been mostly of a jobbing character, and without positively new features.

STEEL PRODUCTION.—The capacity of the steel works of the world at the present time, is figured at about 3,000,000 tons per year. The Bessemer works of the United Kingdom, with 120 converters, contribute to this total from 750,000 to 800,000 tons; the United States, with probably half as many converters, but much superior plant and management, produce 750,000 tons more. Germany has lately greatly increased her capacity for steel production, and at present can produce about 500,000 tons; France produces 275,000; Belgium, 150,000; Austria, 250,000; and Sweden and Russia about 150,000 tons.

Bogus Medical Schools.

Decent people everywhere will rejoice to learn that at last a stop has been put to the operations of the institutions in Philadelphia which for years have brought disgrace upon the city and State which permitted them to exist so long, and upon the country, by their shameless traffic in medical diplomas. Nothing could better illustrate the laxity and deficiencies of the laws in force for regulating the practice of the learned professions, than the fact that during the brief period which these fungus institutions existed, they succeeded in almost flooding this country with licenses to kill, and even extended their nefarious operations across the Atlantic. There was no lack of evidence to prove the utterly disgraceful character of these institutions long ago, but between the indifference of the city authorities on the one hand, and of the respectable medical schools and associations of the city and State on the other, they plied their infamous traffic without serious let or hindrance. Had their suppression depended upon one or the other of these, they would in all probability, between legal red tape and mawkish professional dignity, still be doing a flourishing business; but, fortunately, one of the daily newspapers of Philadelphia, the *Public Record*, to which too much credit cannot be given, determined to stamp out these disgraceful excrescences. The work of securing evidence of the shameless sale of medical diplomas for money, was speedily accomplished; indictments were at once found against the institutions for violation of their charter privileges; the evidence presented was conclusive and damning; and the charters were declared forfeited. What was thus successfully and promptly effected by an enterprising and public-spirited newspaper, should, and could have been effected long ago, had the proper effort been made by the city or State officers, or by the respectable medical schools and associations of Philadelphia. For the prolonged existence of the bogus diploma shops, and for the incalculable evil that has been and will continue to be inflicted on the public by the professional performances of their "graduates," they are largely responsible.

We have reason, however, to be thankful that the work of crushing these infamous institutions has at last been accomplished. Now, it remains to see that the rogues who conducted them are properly punished for their crimes, and that their "graduates" are hunted out of every community in which they are shameless enough to show their faces. For this last service the public must look to the medical profession. Let respectable physicians in every community organize a crusade against these unprincipled charlatans.

Tenement Houses.

A writer in the *American Architect and Building News* is giving a series of able articles to the public on "The Tenement House Problem." Though in Chicago this "problem" has not attained to such serious import as in the older cities, it is beginning to be discussed by builders and humanitarians. The frame buildings erected before the fire ordinance went into effect were put up in a great hurry in anticipation of it, and many have grown unsafe, and all or more or less uncomfortable for residence. It is not unlikely that in the districts most occupied by the laborer a few tenement houses would prove to be a paying investment. If they were plainly and conveniently constructed and rented at from five to fifteen dollars per month for each suite, there would be no difficulty in getting tenants.

The cottages and flats which we have been in the habit of erecting here are too high-priced for laborers earning from 80 cents to $1.25 per day, and these people are obliged to live in shanties or hovels, uncomfortable and unhomelike in every sense. They are unable to afford car fare to country homes, or build for themselves in the city, under the stringent conditions of the fire ordinance, and they have no alternative but to huddle together, two or three families on each floor. Under such conditions, cleanliness and comfort are out of the question.

How to build these houses is the problem. The writer mentioned is evidently practically educated in the business, and an extract from his second paper may interest the reader:

"In building a tenement-house it is first of all necessary that it should be adapted to its purpose by the convenience and comfort of its arrangements. The best of sanitary appliances and fire-proof constructions fail of appreciation at the hands of the ordinary tenant, if they be not recommended by the more palpable advantage of 'having things handy.' No one of us, in fact, can be induced to enjoy that sweetmeat which has the appearance of medicine.

"The systems of arrangement which have been employed are easily classified. Historically, the movement has been in the direction of separation and self-contained dwellings.

"Considering first the general arrangement of the blocks, we find that those who have studied the matter hold to separation, and division by streets and alleys, rather than the agglomeration around a number of small and confined courts pursued in France. Such plans have been strongly advocated in London, and have been urged in our own country by architects like Mr. Potter and Mr. Post. By means of such separation, although a slight amount of space may be wasted, free passage is obtained for currents of air, all temptation to inner dark rooms is avoided, and the tenants are somewhat relieved from the feeling of being huddled together in indiscriminate communities. While it seems impossible that any system other than that of the flat should be made available for the purpose in the midst of large cities, there is certainly no reason why our city blocks should be made so painfully solid. This solidity gives a seeming economy of space, but a real waste thereof in many dark corners, as was seen in the recent tenement-house competition.

"Another admirable form is that of a large block, bounded by the ordinary streets, and arranged around a large central court with wide approaches on the several sides. It is asserted that this method furnishes an amount of sunshine and of open recreation-ground impossible upon the system of narrow auxiliary streets; but is somewhat extravagant of space, necessitates the use of occasional light and air shafts, and bears an undoubted resemblance to the much-dreaded barrack. Where dividing alleys are used, moreover, it would be possible for several owners to build upon the same block, under competition, but by a co-operation much more simple than that required for the erection of one immense building.

"The number and width of the subordinate streets, or the size of the central court, would be determined by the plans and situation adopted; but probably very few separate blocks would be erected without accommodation for more than the four families per floor found practicable in the city-lot tenement. Coming then to the internal arrangement of the block itself, the question itself resolves itself into one of the grouping of a number of families about the staircases and passages of approach.

"The simplest and earliest of all methods of grouping is that with which we have grown uncomfortably familiar in our hotels, that of one or two staircases giving admission to a long central corridor, with rooms opening on either side. This proves unsatisfactory for many reasons: the hall is unlighted and difficult to keep in order, and each set of rooms is inconveniently and uneconomically arranged. If the long corridor be placed on one side, it gains more than its due share of light and air, and compels dark rooms in each tenement, or a great waste of space. To gain the light from both sides of the building, and at the same time free access to a long series of rooms by means of as few staircases as possible, what is known as the gallery system was adopted. In this system the long corridor is simply made external, windows as well as doors opening upon it on one side, the other being entirely open to the light; the staircases, in the later work, being also exterior. The advantages claimed for the gallery system upon its inception were, that it furnished covered walks in bad weather, lounging places, and places for flowers, an economical exit in case of fire, an open space for drying linen, and an easy access for itinerant vendors! Nearly all these advantages have been found worse than useless by experience as well as by argument. In houses of such a type, lounging places afford dangerous temptations to fights; flowers find no safe abiding place upon so common a highway; long lines of wet and flappping clothing are far from being ornamental or convenient appendages to a front balcony; and itinerant vendors have happily almost passed away, and no encouragement should be offered for their resurrection. The strength and durability of these slender iron galleries might seriously be questioned in case of fire, while they interfere with the complete and frequent separation so necessary in fire-proof construction. It may also be urged that there can be no privacy in rooms which look directly upon the common passageway; and there is certainly no privacy of access. The rooms opening upon these galleries, moreover, are seriously darkened. The one argument in favor of the system is that it is the only one which provides a reasonable amount of light and air to a long series of apartments reached only by a single staircase. A good example of it in its latest form is visible in Mr. White's 'Tower Buildings' in Brooklyn.

"To the multiplication of staircases most builders object on the score of cost and of wasted space; they do not seem to reflect that a reasonable number of staircases is necessary to safe and rapid exit in case of fire or panic. By means of staircase openings comes also much of the scanty ventilation of such houses. In the earlier plans in which staircases were multiplied, one staircase, placed in a corridor transverse to the building, was then thought necessary for each pair of dwellings. Later students succeeded in making one staircase serve for four dwellings. One of the best of the recent devices is that of Mr. Chancellor, first used in London in 1874. The plan, which he denominates the 'balcony plan,' offers some of the advantages of the older gallery plan; but each balcony belongs to a single family, acts merely as an open lobby, and can be shut off at will from the open staircase, which is placed in the middle of each division of his block. This plan differs from the dumb-bell plan on which most of the city-lot competition designs were based, in having the sides of the block, used by us for party-walls open to the light and air of the auxiliary streets—which Mr. Chancellor recommends, thus gaining an opportunity for extending his blocks to an indefinite length."

Waste in Coal Mining.

There is one important department of industry in which there is an urgent demand for improvement. We refer to the enormous waste attending the mining of anthracite coal, and its preparation for market. As a fuel for domestic purposes, Pennsylvania anthracite has no equal, and what makes the necessity of economy more imperative, is the fact that the territory in which it is found is very limited and the supply by no means inexhaustible, as many writers have grown accustomed to assert. It seems astonishing, in view of the vast improvements that have been made in the arts, that the same old crude and wasteful methods that have been in vogue for centuries should still be followed in the getting of coal. But such is nevertheless the fact, and it remains a standing reproach to the ingenuity of our inventors that only 40 per cent of this indispensable fuel finds its way to market, the other 60 per cent being wasted either in the mine or the breaker. This enormous percentage of waste seems out of all proportion when we consider the economies that are accomplished in the crudest and most primitive industries. It is incredible that there should be no means of stopping this fearful loss of good material, and the inventor who will devise a practical method of doing it, would not only be a public benefactor, but would reap a rich reward.

Home Department.

Industrial Art in Schools.

From an address lately delivered by Mr. Chas. G. Leland before the Social Science Association, on the subject of "Industrial and Decorative Art in Schools," we abstract the following:

"There are two questions which lie at the basis of social science. One is the providing of work for everybody, the other, 'How shall we educate the young so that while acquiring the ordinary education, they shall at the same time acquire some practical hand-work or art, so that when they leave school they may be able to support themselves?" The reason for this great demand for what is represented by modern idle 'labor,' was that the ancient buildings were profusely decorated with hand-made ornamentation, and that this was mostly of a kind which could be readily learned, while the materials were cheap and everywhere abundant. Labor-saving machinery, while it has increased our comforts, has as certainly degraded art and increased the number of idlers. Fortunately, the new taste in decoration is loudly proclaiming that every object to be really artistic must be hand-made. It also demands that house decoration shall be within the reach of the poor.

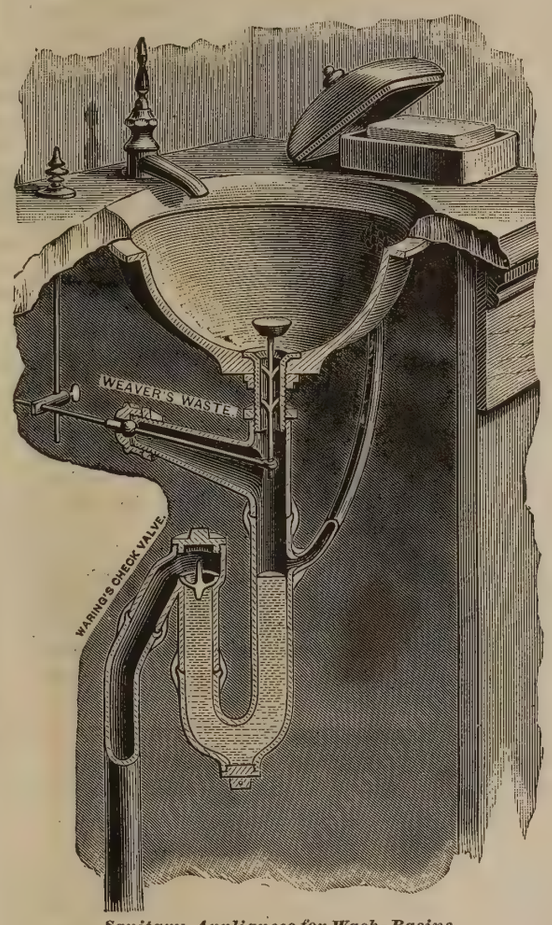
"The ordinary trades, such as carpentry, shoemaking or smithing, require too much strength and time for boys. What we want, is work for the weak and those less gifted as mechanics, though they are often good artists. It is no exaggeration that if the taste for hand-made house decoration becomes general to the extent in which it prevailed all over the world down to the end of the Middle Ages, there would be employment for all our idlers. There are many of these easy arts; among them are making or laying mosaics for walls and pavements, scagliola work, wood and shell inlaying, imbossing sheets of soft leather suitable for covering furniture, door panels and walls, superficial wood panel indenting and carving, repousse work or the chasing sheet metal, stenciling walls, porcelain tiles, ceilings and wood-work, molding in papier-mache and modeling in clay and casting. Many of the beautiful mosaics for floors and walls seen in London are made by female prisoners. The cubes for this work may be either bought or made with a little practice, from any hard stone. The patterns for mosaic and other work should be supplied by government—general, state or municipal—to schools.

"It is a common cause of complaint among artisans that the supply of apprentices is failing. The proper way to meet this want would be to train them to hand-work in the schools. The poorest cottage may be supplied by its inmates at little expense with Pompeiian floors, carved dados, stenciled walls and ceiling, plain yet truly artistic furniture, covered with antique-patterned Spanish stamped leather, at no greater cost than that of time and materials. The great principle, however, to be enforced, is not the practice of these special small arts, but their introduction into all schools of manual industry in any forms which may conduce to develop manual ingenuity. Drawing in schools is not sufficient to make art universal, and it is time lost to wait till a boy is sixteen before teaching him the rudiments of his trade. Teach decorative and industrial work betimes. Teach him something which may prove a source of profit, and much moral good will result. Until hand-work, artistic or practical, becomes a part of the education of everybody, and is regarded as being quite as respectable as a knowledge of dead languages, it will be difficult to realize that republicanism is not in one important respect far behind the Middle Ages."

A Dry Coating for Basement Walls may be made as follows; Take 50 pounds of pitch, 30 pounds of resin, 6 pounds of English red, and 12 pounds of brick-dust. Boil these ingredients, mix them and stir thoroughly, then add about one-fourth the volume of oil of turpentine, or enough to make it flow easily, so that a thin coating may be laid on with a whitewash or paint brush. Walls thus coated are proof against dampness.

Sanitary Appliances for Wash-Basins.

We show in the accompanying engraving several simple and effective appliances which decidedly add to the convenience and wholesomeness of the wash-basin, which has become an indispensable fixture in the house with modern improvements. The Waring sewer-gas check-valve is shown in the form of a valve, seating by its own weight on the termination of a deep water-seal. This seal is made of a decided bend, and is so pronounced, as will appear by inspection of the cut, that its unsealing by siphonage is practically impossible. On the other hand, the effect of any pressure from the sewer end of the pipe will be simply to seat the valve more firmly. It may, therefore, be safely counted on to give practical immunity from sewer-gas poisoning in bedrooms and living-rooms of houses.



Sanitary Appliances for Wash-Basins.

The second of these appliances is known as the Weaver basin-waste, a very sensible substitute for the old-fashioned stopper and chain commonly employed. The new contrivance dispenses with the chain completely. It consists of a solid plug or stopper, closely fitting the opening in the basin, which is closed or opened by raising or depressing a knob at the side of the bowl, which is connected with the plug by a simple combination of levers. This device obviates the troubles and objections of the old stopper and chain. It leaves the bowl free of the chain, thus preventing the annoyance of accidentally drawing the stopper from its place; it avoids the disagreeable necessity of thrusting the hand into dirty water to fish for an invisible stopper, should the chain happen to be broken; and is a positive seal to the contents of the basin when in place. A touch of the knob is all that is required to open or close it. It is made to fit any basin, and can be readily applied to basins already fixed through the hole provided for the chain stop.

The utility of these appliances for sanitary reasons, and for convenience, is obvious. They are manufactured and for sale by A. G. Myers, 94 Beekman street, New York.

People who do not Read Books.

Those who have to deal with the education of the young, get revealing glimpses into the state of culture in the households of our highly intelligent country. A professor in one of our leading colleges, said recently, that a Freshman came to him, after he had been recommended certain books in the literature class, and said he had never read a book in his life. This was literally true; except his text-books, he had never read a book; he had passed a fair examination, but of reading he knew no more than a Kaffir. Another professor, in another college, also one of the highest in the country (both of them are Eastern colleges, in the center of the best culture of America), said more recently that a Sophomore who stood well in his class, came to ask him where he obtained certain facts which he had referred to in the class-room. It came out that the young man never had read a book, did not know what the sensation was, or how to set about it, and had not the faintest conception of literature. He had no notion of the pleasure or profit to be got from reading; the world of books was absolutely beyond his imagination, and he could not conceive what people found in it. The professor at length induced him to read one of Scott's novels, but the boy found it a very tedious and uninteresting occupation. These two instances are extreme, but only in a degree; a taste for literature is not common, and ignorance of it is common, even among college undergraduates.

Care of Children.

Every mother should know that very young children often suffer for the want of fresh, cold water. This they should have every two hours, and more frequently if they become restless and fretful. Fretfulness is generally caused by great thirst. We have recently received a communication from a correspondent, who says: "While making a voyage at sea some years ago, I was greatly disturbed by the incessant crying, or moaning, of a child during the first few days of the journey. The child was about one year old and very delicate. I suggested to the mother that it wanted water. She said that it never, to her knowledge, tasted water, as she thought it dangerous to give it to children so young. I assured her that she need have no fear, and recommended that it should have water every hour, a little at a time, until it became accustomed to it. This was given it, and during the rest of the voyage (of five or six days) I never saw a better or happier child. I believe the child's health was permanently impaired by the constant thirst that during its short life had been consuming it."

The Mechanical Boy.

The mechanical boy should have a shop of his own. Let it be the attic, or an unused room, or a place in the barn or the woodshed. Give him a place and tools. Let him have a good pocket-knife, a gimblet, chisels, gouges, planes, cuttting nippers, a foot-rule, saws, and materials to work. Let the boy have a chance. If he is a mechanic it will come out, and he will do himself credit. If he fails, he is to follow some calling that does not demand mechanical skill. With a foot-rule in his pocket, the boy will be continually measuring. Before he is aware of it, his eye will be educated to judge of dimensions and proportions. It is a good substratum on which to erect the knowledge of practical

mechanics. Acquired as an amusement, this knowledge will become practically useful as the boy develops into the man. The employments suggested by the pocket-knife and rule will occupy many an otherwise idle hour, and afford a pleasant relief to the routine of school study and the weariness of oft-played games. The boy will become acquainted practically with substances, and be interested in the mechanical operations he witnesses, and this will pave the way for his easy entrance on the vast field of useful endeavor before him. He will become an intelligent and willing apprentice, and a judicious and skillful workman. Give the boy a chance.

How to Train the Memory.

Your memory is bad perhaps, but there are two ways of curing the worst memory. One of them is to read a subject when interested; the other is to not only read, but think. When you have read a paragraph or a page, stop, close the book, and try to remember the ideas on the page, and not only call them vaguely to mind, but put them in words and speak them out. Faithfully follow these two rules, and you have the golden keys of knowledge. Besides inattentive reading, there are other things injurious to the memory. One is the habit of skimming over newspapers, items of news, smart remarks, bits of information, political reflections, fashion notes, so that all is a confused jumble, never to be thought of again, thus diligently cultivating a habit of careless reading hard to break. Another is the reading of trashy novels.

The American Institute Fair.

Since the review of the Institute Fair, published in our October issue, some additional exhibits have been put in place and all the available remaining space filled. While there is ample opportunity for criticism, the major portion of the displays are creditable, and in many respects an improvement on those shown last year. The general arrangement of the exhibits is to be commended, for which the managers are deserving of praise, and if a little more discretion were exercised in the matter of permits for space, they would be deserving of still further praise. We feel confident if only exhibits were permitted which possessed merit or novelty, and all advertising schemes abolished, that a better representation of our manufactures would be secured, to the benefit of all concerned.

In making a tour of the building, a number of interesting displays meet the eye. The exhibit made by S. J. Pardessus & Co., of this city, is one of the most conspicuous. This firm have a very fine display, comprising their glass dome skylights and ventilators; and here also is a very handsome exhibit by George Hayes, of this city, the well-known manufacturer of skylights. The display includes all his principal specialties, and is highly creditable to the skill and ingenuity of this enterprising inventor. Various forms of his celebrated ventilating skylights are shown, and are the admiration of all spectators. Besides these, Mr. Hayes exhibits his improved blinds, fluted portable flooring and matting, and attachment for kitchen sinks. A number of other articles of novelty and usefulness are shown in this display, and altogether it is one of the finest at the fair. Our readers have been so thoroughly informed as to the products of Mr. Hayes, that a detailed description of the articles exhibited will not be necessary on this occasion. Another fine exhibit in the main hall is that of the H. W. Johns Manufacturing Company., of this city, who display their well-known products, including their asbestos roofing, boiler covering, and liquid paints. Gardner & Co. exhibit their perforated seating, and show some very handsome designs in chairs and settees. In the machinery department one of the handsomest displays is made by the New York Safety Steam Power Co., of this city, who show several sizes of their vertical engines. These attract a large share of attention and elicit general admiration. A. G. Myers, of this city, exhibits a number of sanitary appliances. Among other exhibitors, are the Blake Crusher Co., who show their crusher; the Farrell Foundry & Machine Co., of Ansonia, Conn., who also exhibit an ore crusher; and the Niagara Steam Pump Works, of Brooklyn, which display the Hardick pump. A fine display of woodworking machinery is made by H. S. Manning & Co., of this city. The Pulsometer Pump Co., of this city, make an attractive display. Household appliances of every conceivable description are shown, including some handsome exhibits of stoves, refrigerators, chandeliers, chairs, beds, mirrors, sewing-machines, and numerous other articles necessitated by the demands of modern life.

Captain Eads' Ship Railway.

The *Scientific American* of November 13th contains two full-page illustrations of Captain Eads' proposed railway for transporting ships, with their cargoes, across continents. Captain Eads claims by his plan to be able to take loaded ships of the largest tonnage from one ocean to the other across the isthmus of Panama, as readily as can be done by a canal after the De Lesseps plan, and at a much less cost for engineering construction. The project is certainly bold and ingenious, and the projector anticipates no serious difficulties in carrying forward his enterprise. The engravings referred to in the *Scientific American* show the proposed construction of not only the railroad, but the appliances for transferring the ships from the water to the rail.

In addition to the large number of engravings, illustrative of engineering works, inventions and new discoveries, which appear weekly, the *Scientific American* has, during the past year, devoted considerable space to illustrating and describing leading establishments devoted to different manufacturing industries. This feature has added very much to the attractiveness and usefulness of the paper. More than fifty of the most important industrial establishments of our country have been illustrated, and the processes of the different manufactures described in its columns.

The *Scientific American* has been published for more than thirty-four years by Munn & Co., of 37 Park Row, New York, and has attained a larger weekly circulation than all similar papers published in the country. The publishers assure the public that they have not printed less than 50,000 copies a week for several months.

Miscellaneous and Advertising.

The Melbourne International Exhibition was formally opened October 1.

The George Place Machinery Agency, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

It has been decided that the proposed trans-Saharan railway shall be preceded by the construction of a telegraph line connecting Algiers with St. Louis in Senegal via Timbuctoo.

It is stated that at the close of the present year no less than 200,000 telephones will be in use in this country. At the beginning of 1879 there were only 12,000; a year later, 50,000.

The Stiles & Parker Press Company, of Middletown, Conn., have just filled an order for a drop-hammer, and shipped it to Costa Rica. To meet the increasing demand for their articles, they have just built an addition to their machine-shop, 60 feet long, of brick, and have added a 60 horse-power engine to their works, without shutting down or any delay.

Messrs. Clark & Co., of 162 and 164 West 27th street, this city, the manufacturers of noiseless, self-coiling steel shutters, have recently completed some important contracts, and inform us that their fall business has been exceptionally good. Their shutters have been steadily gaining in favor, and are gradually replacing those of the old style manufacture.

Heald, Sisco & Co., of Baldwinsville, N. Y., report that they are rushed with work, and have at present many orders ahead. This speaks well for their engines, which have met a want long needed by steam-users—a reliable engine at low cost. This firm manufacture both horizontal and vertical styles, ranging from 10 to 30 horse-power, and from $250 to $400.

The Tanite Company, of Stroudsburg, Pa., have just received an order for one of their improved surface grinders, from the Danforth Locomotive Works. This machine is intended to perfect locomotive slide-bars, and is the second of the kind, the first, we believe, having gone to the Baldwin Locomotive Works. The Tanite Company is also busy at the present time filling an order for nearly three tons of Tanite emery wheels for the French government.

In the new armory of the Seventh regiment, in this city, one of the handsomest decorations is the perforated seating furnished by Messrs. Gardner & Co., of 183 Canal street, New York. Along the north and south walls of the drill-room are two rows of settees, with ash frames and mahogany seats, the rich red color of the first-mentioned wood forming a pleasing contrast to the drab and pale green, which are the prevailing tints along the walls. Settees, which number in all 1,096, are also placed in the galleries at the east and west ends of the drill-room, and contribute not a little to the harmonious and attractive finish of the spacious hall. Gardner & Co. furnished in all about 2,000 feet of seating. They have also just completed a contract for 2,000 opera chairs for the Boston High School.

A Model Home for the Working-Man.

In the illustrations on the opposite page are presented perspective and floor plans of a model home for the working-man, from designs by R. Rosenstock, of 215 West 132d street, New York. It is one of a group of four houses which were erected at Sterling, N. J., for Mr. F. S. Winston, President of the Mutual Life Insurance Company, of this city.

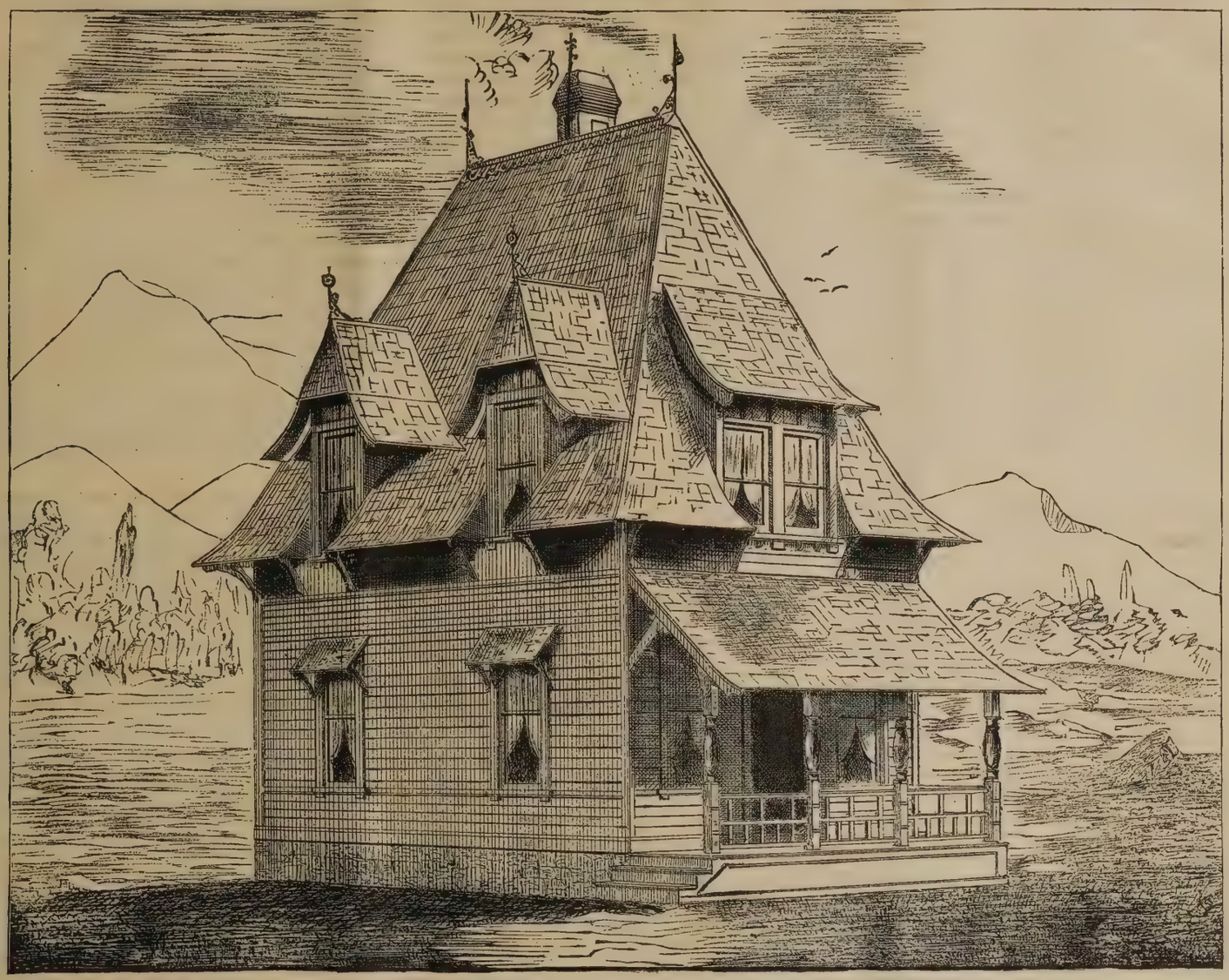
In designing the houses, the architect endeavored to combine comfort, simplicity and artistic effect at a moderate outlay, and an examination of the illustrations will show that he has succeeded in securing these essentials for dwellings of this character, to a remarkable degree. The roof starts about four feet above the level of the second floor, and is carried up very steep, thereby not injuring the rooms on that floor, and being a saving of that much material, which otherwise would have to be used to carry up the story to the required hight.

It will be seen by the floor plans that rooms of comfortable size are provided, also a sufficient amount of closet room, which is not very often found in a house of this kind. The first floor contains but two rooms—the parlor or sitting-room, and at the rear a kitchen or living-room, provided with a sink and water, also a china dresser. Water is supplied from an artesian well. From the kitchen, the stairs lead to the cellar, which is of the full size of the house. Access to the upper floor is had by the stairs direct from the parlor.

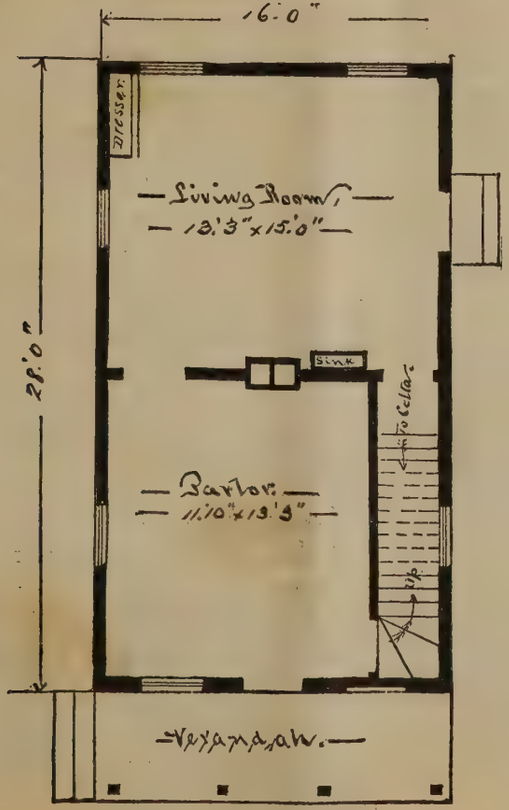
The second floor consists of one large and two smaller bed-rooms, with closet room.

The interior is finished in a neat and substantial manner, neat cornices and center pieces being in the main rooms. The exterior is painted a deep French-gray; brackets, window-sash, chamfers, and roofs painted in Indian-red; and outside shutters in deep olive-green, thereby insuring a harmonious blending of colors.

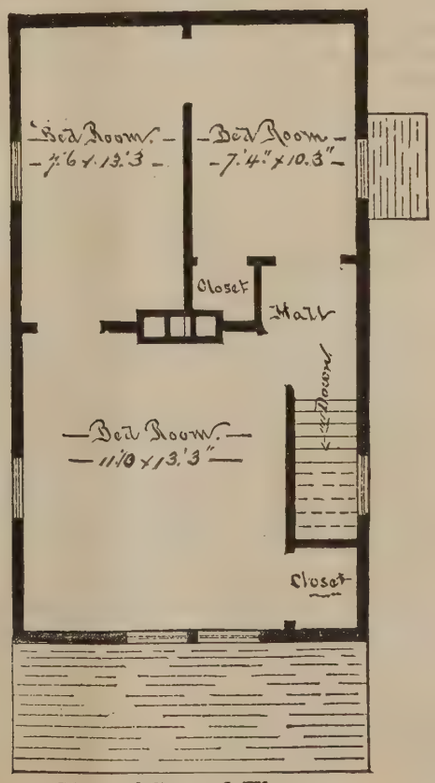
This cottage was built at the small outlay of $900, including the artesian well. If any further information is desired relative to this cottage, it will be cheerfully furnished by the architect, who may be communicated with at the address above mentioned.



DESIGN FOR A WORKING-MAN'S HOME, COSTING $900.



Plan of First Floor.



Plan of Second Floor.

Adulterations of Food.

Abstract of a paper read before the meeting of the American Social Science Association, at Saratoga, by Professor S. W. Johnson.

To read the many undeniably authentic and the many more apparently true accounts of the tricks that are stated to have been practiced upon human food, here and there, formerly and recently, is really a shock to one unprepared for the dismal story. The revelations of the experts who have studied these matters are of a sort to exasperate and enrage any honest citizen. Worse than that, they not only convince us that a great deal of other people's food is fraudulently made unfit for any human stomach, but they actually unfit our own stomachs, temporarily at least, for any food whatever.

Knowledge of the nature and extent of adulterations that have been practiced, is the first requisite in protecting ourselves from those that may be attempted; and here follows a brief account of some of the most conspicuous falsifications which are said now to be or recently to have been practiced on a few common articles of diet.

The statements here made are many of them correct beyond question, others are given on what passes current as good authority, but the writer cannot in all cases vouch for their truth.

Wheaten flour, which makes the most palatable and nutritious bread, has long been the subject of falsification. The most usual and most harmless adulterations have been the flour of other cheaper grains or seeds. Flour of rice, of barley, of peas, beans, buckwheat and of doura or Egyptian millet, it is said, have thus been employed in England. It has long been a habit of many good housewives to add a small proportion of boiled potatoes to their wheaten dough in making bread, and this and similar mixtures are entirely proper in domestic bread so long as those concerned are satisfied; but in the hands of the British bakers, if we may credit English authors, the same practice has been adopted for the twofold purpose of employing a cheaper flour and of retaining a greater percentage of water in the loaf. This mode of extorting larger profits from the public is justly regarded as an adulteration and a swindle.

A curious feature in British bread-adulteration is presented in the history of the so-called "cones flour." This is supposed to have been originally the flour of a particular variety of wheat which was sold to bakers for the purpose of dusting their kneading troughs as well as the fashioned loaves to prevent the dough from sticking where it was not wanted. It is evident enough that any flour that is fit to make dough of is suitable to restrain the adhesion of that dough, and what the peculiar merits of cones flour once were cannot be clearly made out. But cones flour, or "cones" as the bakers termed it, was speedily made the means of turning a multitude of dishonest pennies, and its sale and consumption increased enormously until some master bakers directed their journeymen to mix a bushel of cones with a sack of flour,—more than enough to fully test the "dusting" power of the "cones," one would suppose. In short it appears that "cones" became the trade name of an article which was represented to have qualities serviceable in the manipulation of the baker's shop, but which was really a cheap and inferior flour valuable for putting money in the pockets of miller and baker and for dusting the eyes of the police and health officers. We may well imagine that when the millers began to commend cones to the bakers as an "artful dodge" to further the interests of the trade, the former represented truly what was the real nature of cones at that time, and the bakers most likely thought that an invention which would enable them to get adulterating material under a respectable name was well worth paying for. So the millers thought too, and soon cones became anything that would swindle the public and if possible the bakers also and contained no wheaten flour at all, but was a mixture of the cheapest materials that could pass muster as a breadstuff.

Since free trade was adopted in England that country has been the head center of all kinds of adulteration. In 1860 the British parliament began a series of enactments to prevent the adulteration of food, drink and drugs, and in consequence of the investigations that accompanied these enactments a large mass of literature on the subject of food-adulteration has been published in the English language. This literature consists in the record of the researches of scientific men and in testimony elicited in the courts from experts and detectives, as well as from adulterators grown rich enough to retire from business or induced by prospect of greater profits to turn state's evidence.

To return to bread-adulteration, the use of bean flour is said to have been resorted to in order to give due tenacity and lightness to bread made from damaged wheaten flour. Boiled rice was employed to increase the quantity of bread to be obtained from a sack of flour. A sack of two hundred and eighty pounds should yield, according to Letheby, ninety-five four-pound loaves; but by adding three or four pounds of rice boiled for several hours in as many gallons of water to the flour, at least a hundred four-pound loaves can be got,—a gain of twenty pounds of bread, or more than five per cent. By this use of rice or of boiled potatoes, which being nearly pure starch are perhaps even more effectual than rice, the bread is indirectly adulterated with water.

Inferior flour is produced in immense quantities from grain damaged by incomplete growth, by injury from wet in the harvesting or storing, by incipient sprouting, mold or mustiness, as well as by the presence of the seeds of other plants. Flour itself once good is damaged in transportation and in storage. The endeavor to make an apparently good bread from cheap or even damaged flour is probably the reason why certain chemicals have been widely used in the making of bread.

(To be Continued Next Month.)

New Publications.

The Anthracite Coal Fields of Pennsylvania, and their Exhaustion. By P. W. Sheafer, Engineer of Mines. Together with a Diagram of the Progress of the Anthracite Coal Trade of Pennsylvania, with Statistical Tables, etc. By the Messrs. Sheafer, Engineers of Mines, Pottsville, Pa.

The authors of this paper and chart are well known engineers of long professional experience in the anthracite region of Pennsylvania. The chart, which illustrates graphically and by tables the contents of the paper, is interesting and valuable. It shows graphically the gradual growth of the anthracite industry, with the dates of the opening of new fields and new avenues to the markets. It shows, in the same manner, the estimated quantity of anthracite coal in the several coal fields of Pennsylvania, the relative amount of waste and quantity already mined and wasted, which affords a highly instructive illustration of the crudity of our present methods of mining and preparing coal for consumption. A view is given of a cross section in the southern anthracite coal field of Pennsylvania. The statistical portion of the chart, arranged in tabular form convenient for reference, embraces the following important subjects: The out-put of anthracite coal in each of the several regions from the commencement of production to the present time; coal areas of the world in square miles; coal product of the United States for 1878 and 1879; coal out-put of the globe; coal exports; anthracite coal areas of Pennsylvania owned by the several companies; statistics of the coal and iron trade of the United States and Great Britain, and railroads of the United States; oil product of Pennsylvania; the world's production of pig and cast iron; together with other useful information, which renders it of special value for reference.

Mr. Sheafer in his paper especially deplores the "fearful loss of good material involved in mining and preparing anthracite." He estimates that, on an average, not more than 66 per cent of the coal is ever taken out of the mines, and 20 to 25 per cent more is wasted in running it through the breaker, bringing up the total of waste to the enormous figure of 60 to 65 per cent. The total quantity of anthracite still remaining to be mined, Mr. Sheafer places at 26,361,076,000 tons. Taking the total waste at two-thirds of the deposit, this reaches the appalling total of 17,574,050,666 tons, leaving us only 8,787,075,533 tons available for use. Assuming a rate of increase of production, based upon the increased rate of consumption during the past ten years, Mr. Sheafer estimates that we shall reach our maximum output of 50,000,000 tons about the year 1900, and that we will finally exhaust the anthracite supply in 186 years.

From these interesting figures, it will appear that those who have been laboring under the impression that our anthracite coal fields were practically inexhaustible, will do well to modify their opinion.

The Encyclopædia Britannica. A Dictionary of Arts, Sciences and General Literature. Ninth edition (American reprint). Vol. XI. Philadelphia: J. M. Stoddard & Co. 1880.

The standard character of the "Encyclopædia Britannica" is universally known and acknowledged by scholars of all professions, and its sterling value is being fully maintained in the ninth edition now in course of preparation. The present volume is the eleventh of the series. From the immense number of topics embraced in the volume, we need simply select a few having a scientific bearing, with the names of their authors, to show that the publishers have secured the very best living authorities in their respective specialties to contribute to the work. The following will serve as examples: Granite, F. W. Rudler, F.G.S.; Gravitation, R. S. Bell, F.R.S., Royal Astronomer of Ireland; Gun-Cotton, Fred. A. Abel, F.R.S., Director of the Chemical Establishment, War Department, Woolwich; Gunnery, Col. E. Maitland, R.A.; Harbors, Thomas Stevenson, C.E.; Harvey, Dr. P. H. Pye-Smith, Guy's Hospital; Harmonic Analysis, Prof. J. Clerk Maxwell, F.R.S.; Heat, Sir William Thomson; Heating, Capt. Douglas Galton; Herculaneum, Prof. E. Barnabei, Government Archæological Department, Rome; Hermes, W. M. Ramsey, M.A.; Hieroglyphics, Reginald S. Poole, British Museum.

The publishers of the American reprint, Messrs. J. M. Stoddard & Co., have spared neither labor nor expense to maintain the strict accuracy of the text of the original, and the mechanical execution of their publication is excellent in every particular.

Modern Architectural Designs and Details. Part I. Bicknell & Comstock, 194 Broadway, New York. 1880. (Plates). Price, $1.

The work above named, of which sample plates have reached us, promises to be a valuable addition to architectural literature. The work, as announced by the publishers, will be completed in ten parts, to contain in all 80 lithographic plates (9×12 inches), representing new and original designs of moderate cost in the Queen Anne, Elizabethan, Eastlake, and other modernized styles, including a variety of miscellaneous exterior and interior details of dwellings, stores, offices, etc.; likewise a variety of designs of low-priced cottages in popular styles, suited to seaside and summer houses.

These drawings, the publishers announce, will include selections from the latest designs of prominent American architects, as well as many original ones, prepared specially for the work. All elevations and details will be drawn to scale. The ten numbers will each contain 8 plates. Proof-sheets of Part I., which have reached us, indicate that the publishers intend to keep the work fully up to the standard they have announced in their prospectus, and from these specimens we feel prepared to commend it to the favor of our readers.

American Health Primers. "The Skin in Health and Disease." By L. Duncan Bulkley, M.D., Attending Physician for Skin and Venereal Diseases at the New York Hospital, late Physician to the Skin Department of Demilt Dispensary, New York. Philadelphia: Presley Blakiston. 1880. Price, 50 cts.

This number of the "American Health Primer" series of Mr. Blakiston is one of the most valuable on the list. It treats of the anatomy and physiology of the skin; the care of the skin in health; diseases of the skin; and of diet and hygiene in diseases of this class. It is well known that many of the diseases that are included in this class are peculiarly trying to the patient and very obstinate in banishing, and a proper elucidation of their character, such as Dr. Bulkley gives in this little volume, will be found interesting to all intelligent readers, and of special value to those who suffer from any of the numerous affections of which he treats. The author prefaces his work with the statement that he has endeavored to make this Health Primer serve both as a guide for the preservation of the health of the skin and as a popular dictionary or encyclopædia in matters pertaining to dermatology. This statement fairly represents the scope of the work.

OTHER PUBLICATIONS RECEIVED.

Report of the Chief of Engineers to the Secretary of War, for the Year 1879. Three volumes. Washington: Government Print. 1879. From the Chief of the Bureau.

Eleventh Report of the State Board of Health of Massachusetts, for the six months ending June 30th, 1879. Boston: State Print. 1879. From Dr. T. R. Walf, Newark, Del.

Proceedings of the Convention of Agricultural Chemists, called for the purpose of adopting a uniform method for the analysis of commercial fertilizers, held at Washington, D. C., July 28th, 1880. From the same.

The Western Farmer in America. By Augustus Montgredien. Cassell, Petter, Galpin & Co., London, Paris and New York. From the Publishers.

Second Geological Survey of Pennsylvania. Lancaster county and maps C C C. By Persifer Frazer, Assistant Geologist. From Hon. John Lamon, Philadelphia.

Geological and Natural History Survey of North Carolina. Part III. Botany; containing a catalogue of the indigenous and naturalized plants of the State. By M. A. Curtis. Raleigh: State Print. From W. C. Kerr, State Geologist.

Quarterly Report of the Chief of the Bureau of Statistics, Treasury Department, relative to the Imports, Exports, Immigration and Navigation of the United States for the three months ended June 30th, 1880. Also containing other statistics relative to the trade and industry of the country. Washington: Government Printing Office.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of THE MANUFACTURER AND BUILDER. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2700) BALLOONING.—Who first discovered the art of ballooning? and who made the first ascension in a balloon?—W. J., Wilkesbarre, Pa.

(2701) RECOVERING TIN FROM TINNER'S WASTE.—Can you give me any information on the subject of recovering tin from tinner's waste? I would like to know if there is any simple way of profitably recovering the tin.—C. H. H., Greenpoint, N. Y.

(2702) GRAMME'S REVOLVING ARMATURE.—Will you please inform me whether anything has appeared in back numbers of your journal, giving plain instructions as to how the Gramme ring or revolving armature is constructed in the Gramme magneto-electric machine. If not, I wish to be informed whether you could give a description sufficiently plain to show how the bobbins are wound and connections made.—T. M., Denver, Colo.

(2703) CULTURE OF THE LEECH.—Do you know of any work published on the culture of the medicinal leech?—W. H. R., New Philadelphia, O.

(2704) PATINA ON BRONZE.—Please give me directions for the green finish on bronze and bronzed goods.—C. W., Philadelphia.

(2705) CAN A STEAM PIPE SET FIRE TO WOOD?—I clip the following item from one of the numerous papers in which I have seen it quoted. Will you give me your opinion of its correctness. I had always been of opinion, that, under ordinary circumstances, as in buildings using steam for heating, accidents from this source were not to be feared. In the case quoted, however, the steam is used at much higher pressures than is the case with steam pipes for heating purposes in buildings. I append the quotation I refer to: "The *American Manufacturer* says that at the Crescent Steel Works in this city, a steam pipe 2½ inches in diameter, carrying from 90 to 100 pounds pressure, was laid under ground about three years ago, encased in common pine boards about one inch thick. A few days since occasion was had to dig up the pipe, and the whole length of the wooden drain was found to be charred and apparently burnt about three-fourths of the thickness of the wood, the other fourth being partially rotted. The whole inside of the drain was turned to charcoal, with here and there spots of white ashes, showing that ignition had actually taken place. It seems probable that if the casing had not been excluded from the air by the earth covering it, it would have blazed and been entirely consumed. It is generally believed that a steam pipe cannot set fire to wood, but this case seems to prove the contrary, and it may explain the origin of many mysterious fires."—G. V. C., Morristown, N. J.

(2706) MEXICAN ONYX.—Is the beautiful, variegated stone called Mexican onyx, now so popular for table-tops, mantels, etc., properly named?—W. R. T., Raleigh, N. C.

(2707) THE SHOWER OF FLESH.—Will you please tell me in your answers to correspondents, if the shower of flesh, that was reported several years ago to have fallen in Kentucky, and which was much talked about in the newspapers at the time, was really a genuine occurrence; and if so, whether it was ever satisfactorily explained.—J. H. W., Vandalia, Ill.

(2708) SHAFTING AND BEARINGS.—What is the greatest length of 2¼-inch shafting made by manufacturers? What should be the distance apart of bearings?—D. S. H., Lynchburg, Va.

(2709) THERMOSTAT FOR AN INCUBATOR.—I desire to construct an incubator, but do not know how to make a thermostat for it. Can you tell me how to make a simple and inexpensive one? In certain forms of incubators, I believe vulcanized rubber is used. How is it arranged?—R. L. H., Washington, D. C.

(2710) CHEMICAL PROBLEMS.—Will you be kind enough to give solutions to the following questions: 1. The equivalent of chloride of lead to form a given quantity of chloride of zinc. 2. Also, if chloride of lead can be formed by the union of common salt, sulphur and litharge; or the most economical formula for its production.—J. T., Newark, N. J.

(2711) ARTESIAN WELLS.—I have thought it would be a practical idea to sink artesian wells to get water of sufficient quantity and pressure to run water engines. Do you know if it has ever been suggested and tried?—A. H. L., Louisville, Ky.

(2712) MECHANICAL TERMS.—In a descriptive article on handtools that I lately read, I met with several expressions that I do not understand, not being well enough versed with the technical mechanical terms. I will ask of you, therefore, as an old reader, to explain what is meant by the "pitch" of a plane and the "set" of a saw.—M. J., Fishkill, N. Y.

(2713) SHEET METAL FOR PRESSING.—Can you suggest any sheet metal suited for pressing a design with a drop-press, to the hight of say ¼ inch, without cracking? It must be more flexible than sheet iron or galvanized iron, and not more expensive, or very little more, to suit my purpose.—H. K., Mount Joy, Pa.

(2714) LEVER PROBLEM.—I invariably find much to interest and instruct me in your answers to correspondents, but have not asked the favor of a reply to any question as yet, though I have been a reader of your journal for years. A young friend now requests me to ask for a solution of the following problem, which I give as he states it: A bar 84 inches in length and weighing 40 pounds, has a weight of 60 pounds attached to one extremity. Where must the fulcrum be situated so that the bar shall be equally balanced? By giving an answer to this question, you will oblige.—P. F. B., Delaware, O.

(2715) REMOVING STAINS FROM BRICKS.—What will remove black mortar and stains from brick buildings, caused by the rain dripping from window sills and caps?—BRICK-LAYER, New Haven, Conn.

(2716) BOILER-SETTING.—Is there any book devoted to furnace-building, boiler-setting, etc.? You devote considerable space to boiler explosions, etc., why not give an article on setting boilers. What is the most approved plan? If you can, give an article on the Jarvis patent setting, explaining the principle and method.—BRICK-LAYER, New Haven, Conn.

(2717) ARTIFICIAL BLACK WALNUT.—Can you give one of your readers a good recipe for a black walnut stain that would be good enough to use on fine cabinet work?—W. C. M., Watertown, N. Y.

(2718) WHY A PUMP WILL NOT LIFT HOT WATER.—Will you please explain why it is that a suction pump will not lift hot water.—C. F. H., Sedalia, Mo.

REPLIES.

(2700) BALLOONING.—The secret of aerial navigation was discovered in France by the brothers Stephen and Joseph Montgolfier. They were led to their discovery by reasoning from the natural ascent of smoke and heated air, that a bag or vessel filled therewith, would, from their natural inclination to rise, carry the vessel up with them. Their first experiment, it is said, was made in their own chamber, at Avignon, in France, about the middle of November, 1782, with a paper bag. The lower part of this had an orifice, to which they applied burning paper. It thereupon began to distend itself, and on being released, ascended to the ceiling of the chamber, much to the satisfaction of the experimenters. Encouraged by the successful termination of their first experiment, the brothers repeated it in the open air. Here again, after it was inflated and released, it ascended to a hight of about 70 feet. The experiment was then tried on a larger scale, with a spherical envelop having a capacity of about 600 cubic feet. On trial, this experiment far exceeded their most sanguine expectations, for, after being inflated, its ascensional force became so great that it broke away from its fastenings and ascended to a hight of 600 or 700 feet, and descended soon after in the immediate neighborhood. They next constructed a balloon—so called from the resemblance the air vessels bore to the large, round, short-necked chemical vessels known by that name—35 feet in diameter, having a capacity of 23,000 cubic feet, with which they made a public exhibition with entire success. The immense bag was safely inflated, and arose majestically into the air amidst the plaudits of an enthusiastic multitude gathered to behold the novel sight. It ascended to the hight of six or seven thousand feet, and fell to the ground about a mile and a half from the place of its departure. This experiment was made at Annonay, on Thursday, the 5th of June, 1783. The first living creatures to make a balloon voyage, were a sheep, a cock and a duck, which were sent up by one of the Montgolfiers in a Montgolfier (as hot-air balloons are called, in honor of their inventors), at Versailles, in the presence of the King of France and the royal family. M. Pilatre de Rozier, with a larger Montgolfier, provided with special arrangements to allow the occupant to supply fuel as it became necessary, made several ascensions to the hight of several hundred feet, the balloon being held to the earth by ropes. He determined, therefore, in company with a friend, the Marquis d'Arlandes, to make an aërial voyage. This determination they carried into execution on the 21st of November, 1783. The merit of having made the first balloon voyage, therefore, belongs to these two gentlemen. A full account of their voyage, which, with the crude and dangerous apparatus they used, was highly exciting and hazardous, will be found in the interesting work of the famous but unfortunate American aeronaut, John Wise, entitled "Through the Air," from which we glean the facts above given. The experiment of De Rozier and D'Arlandes aroused immense enthusiasm everywhere, and they soon had many imitators in various European countries. The French Academy then undertook the demonstration of a new principle in experimenting with gases lighter than air, to take the place of air rarefied by heat. Under the auspices of this body, a balloon was inflated with hydrogen gas, and its ascension successfully accomplished. On the 17th of December, 1783, MM. Charles and Roberts made the first aërial voyage in a balloon filled with hydrogen gas.

(2701) RECOVERING TIN FROM TINNER'S WASTE.—Many plans have been proposed and tried for the recovery of the tin from tinner's scraps; but we are not assured that any of them have proved to be sufficiently profitable to make the operation a remunerative business. One cause of this indifferent success, we believe, may be explained by the fact that by far the greater portion of the tin plate used consists of the lighter sorts, which have a very thin coating, not exceeding probably 3 to 5 per cent of the weight of the plate; and also, partly by the fact that the coating is not all tin, but contains more or less lead, according to quality. So that the amount of tin that may be recovered by subsequent treatment of clippings and waste, is quite small. We give below a plan which we consider to be the simplest and most promising of any we know of, for the recovery of tin from such refuse, though, as above remarked, we are not assured that this or any other plan can be worked with much profit. Cover the scrap, in a suitable vessel—say a wooden vat—with moderately concentrated muriatic acid, which should be allowed to saturate itself completely, removing the scrap as fast as it is scaled, and replacing it with fresh material, so long as the acid continues to act. When the acid appears to be spent, it should be drawn off and slightly diluted with water, by which the greater part of any lead that has been dissolved will be precipitated as chloride. When this has settled, the clear solution of proto-chloride of tin should be siphoned into another vat, and then treated with granulated zinc, which precipitates the tin in the form of a metallic powder which collects at the bottom. The zinc must be renewed as rapidly as it disappears, until the action appears to be complete. The tin powder can be collected, washed, melted in a crucible with or without the addition of a flux, and cast into ingots. The liquid remaining in the vat is a chloride of zinc, a commercial product, which we think can be sold at a price sufficient to pay the cost of the operation, leaving the tin to represent the profits of the work.

(2702) GRAMME'S REVOLVING ARMATURE.—This correspondent will be able to obtain the fullest and most complete information respecting the details of the construction of the Gramme dynamo-electric machine, by consulting Mr. Gramme's patents, which are very elaborate as regards drawings and description. The number and date of the English patent are No. 1668 of 1870. The number and date of the American patent are (Gramme & D'Ivernois) No. 120,057, October, 1871. The information asked is somewhat too technical to be given without the aid of several engravings and a somewhat lengthy description. Should our correspondent not be able to consult the English patent at one of the local libraries in his town, he will have no difficulty in finding a set of the American specifications. But should he fail in this, he will be able to obtain copies of the specification and drawings of the American patent, which will give him the information he desires, through any of the local patent attorneys of his town, or by addressing the Commissioner of Patents, Washington, D. C., stating the number and date of issue of the patent, and enclosing the sum of 25 cents for each patent specification.

(2703) CULTURE OF THE LEECH.—We have no knowledge of any special work published on the culture of the medicinal leech; nor have such of our medical friends as we have asked the question. Fugitive articles have now and then appeared in newspapers and magazines respecting the culture of the leech, as conducted in certain European countries, where, it is related, they are cultivated in ponds and fed daily. For this purpose, it is said, worn-out and condemned horses are driven into the ponds, and the leeches attach themselves to the legs of the poor creatures, which are kept in the water until they begin to show signs of weakness from loss of blood. When full grown, the leeches are collected and shipped in boxes filled with moist earth and vegetable mold, to their destination. The use of leeches, it is well to add, is by no means so common now as it formerly was. This correspondent will find interesting paragraphs on the medicinal leech in Appleton's and Johnson's encyclopædias, and in the "Encyclopædia Britannica."

(2704) PATINA ON BRONZE.—The greenish or bluish finish, which is an imitation of the natural patina, that makes its appearance on bronze objects long exposed to the atmosphere, may be imitated as follows: Prepare a paint of carbonate of copper and any light spirit varnish, and apply it to the object with a brush on the places where it is desired to have it appear. With carbonate of copper, this tint is bluish; with verdegris, a light green is produced; and intermediate shades of color can be obtained by mixing the two in varying proportions.

(2705) CAN A STEAM PIPE SET FIRE TO WOOD?—We do not consider the quotation cited by this correspondent to be convincing, and in passing judgment on the case, from the evidence presented, we would incline to render the Scotch verdict of "not proven." The circumstances of this case are quite exceptional, bearing no analogy to the case of a steam pipe in contact with exposed wood-work. Here the pipe is buried under ground, where in all probability it was exposed to alternations of steam heat and ground moisture, a combination of circumstances that would rot the wood much more rapidly than the action of moisture alone. After the rotting of the wood had fairly set in, it is not difficult to conceive of the complete carbonization of the moldering wood fiber by the heat of the pipe. Steam at 90 to 100 pounds pressure would have a temperature of about 320° to 350° Fah., which, acting on the decomposing material in contact with it during so extended a period as three years, would make it difficult to distinguish the portions most severely affected (that is, those nearest to the pipe) from charcoal. Yet this case does not prove that a steam pipe can set fire to wood, for we find nothing in the quotation to show that this particular lining was on fire—"the white spots of ashes here and there," were more than likely something else than ashes, and the carbonization of the wood, as we have endeavored to show, is probably only a case of very complete molder-

ing under exceptionally favorable circumstances. With regard to the firing of exposed wood-work in buildings from steam pipes, under ordinary circumstances, we incline to the belief that our correspondent's opinion is correct, and that, as he says, "accidents from this source are not to be feared." We are aware that there are a number of apparently well-authenticated cases of this kind on record, but we are, nevertheless, of the opinion that there must have been some unnoticed circumstance that was the predisposing cause of the firing in the cases in question. Messieurs Pelouze and Frémy, who have made the most careful and reliable experiments that we have, to determine the temperature required for the ignition of various combustible substances, have determined that very dry pine wood requires to be heated to 800° Fah. before ignition will take place, and that very dry oak must be heated to 900°. Now, it is quite beyond the range of probability that anything approaching these temperatures should be attained in steam pipes, and certainly not in pipes used for steam-heating. It is true that at temperatures considerably below those named, say 450° to 500°, wood is rapidly charred; but the temperature of ignition of the most inflammable charcoal is 500° Fah., a temperature that would represent steam at not less than 675 pounds pressure. The utter improbability of causing the ignition of wood-work by steam pipes in buildings where they are employed for heating purposes, and where the steam pressure rarely exceeds 20 or 30 pounds (corresponding to 260° to 276.4° Fah.), is apparent. It is not impossible that oily or greasy cotton-waste rags, or other waste materials, carelessly thrown, or allowed to accumulate, on the floor in close proximity to a heated pipe, would cause the speedy ignition of wood in the neighborhood of a steam pipe, by their spontaneous combustion; and some such contingency as this may possibly account for the origin of fires that have been incorrectly attributed to the direct firing of wood by steam pipes.

(2706) Mexican Onyx.—The name is arbitrary. The name onyx was originally given to agates which had the appearance of a nail where it joins the flesh; but for a long time it has been used to designate agates which exhibit marked contrasts of color in bands or circles, such as black and white, or black and whitish-gray, etc. The onyx, it is said, is very cleverly imitated by heating agates, immersing them then in thinned honey, or other organic solution, and then subjecting them to a heat sufficient to char the absorbed material. As some of the bands of agate are quite impervious and others more or less absorptive of moisture, the contrast of the bands by this means is greatly enhanced. The so-called "Mexican onyx" has no relation whatever to the onyx proper, but has probably received its name from the strongly contrasting variegations which its polished surfaces present, and which remotely suggest a resemblance to the onyx. The Mexican onyx is a carbonate of lime, colored with ferrous and manganous oxides.

(2707) The Shower of Flesh.—We believe the occurrence referred to by J. H. W. was a genuine one. It had quite passed out of our recollection, but we remember that a number of explanations, more or less absurd, were offered at the time to account for it. The most reasonable one, we incline to think, is that the fall of flesh was nothing else than the result of a sort of post-prandial disgorging by a large flock of buzzards which had been feasting more abundantly than wisely on over-ripe carcasses. It is said to be a fact, that it is not uncommon for buzzards thus to relieve their overcharged stomachs, and that when one in a flock commences this relief operation, the others are excited to nausea, and a general shower of half-digested meat takes place. This seems to us to be the most reasonable way to account for the curious circumstance referred to.

(2708) Shafting and Bearings.—The length of shafting is limited by the appliances in use in the workshop for turning the same. These are seldom constructed for more than 20 to 25 foot lengths, but may without much trouble be adapted for longer shafts. The proper distance apart for bearings of 2½-inch shafting, depends on the transverse strains to which the shafting is subject; 8 to 9 feet apart gives good satisfaction in all ordinary cases. Where none but torsional strains bear on a shaft, the distance apart may safely be made as great as 15 feet.

(2709) Thermostat for an Incubator.—This correspondent will find the same question asked by J. E. Q., of Phœnixville, Pa., and answered in our issue for April, 1880. For his information we refer him to the number of our journal above named. We send him likewise some sketches of practical working mercurial thermostats, which are far more sensitive and reliable than bar thermostats, and easily repaired and adjusted should they get out of order.

(2710) Chemical Problems.—1. The first question of this inquirer will be answered as follows: The relative combining equivalents of chloride of zinc and chloride of lead, are, respectively:

Zn. Cl. Pb. Cl.
32.6+35.5=68.1 103.7+35.5=139.2

Therefore, 68.1 parts (by weight) of chloride of zinc is equivalent to 139.2 parts (by weight) of the chloride of lead; and

$$68.1 : 139.2 :: 100 : x;\ \text{and}\ x=204.4$$

That is to say, 100 parts (by weight) of chloride of zinc is the equivalent of 204.4 parts of chloride of lead; or, 1 pt. Zn Cl= 2.044 pts. Pb Cl. Approximately, therefore, 1 part of the zinc salt is equivalent to 2 of the lead salt. 2. A heated mixture of litharge, common salt and sulphur, would probably result in the formation of some metallic lead, some chloride of lead, and sulphate of soda; but it would be an unsatisfactory method of making chloride of lead. Better procedures are the following: Boil a quantity of oxide of lead, or carbonate of lead, or the mixture of these, known as white lead, with water, and add muriatic acid in small quantities from time to time, so long as the chloride of lead that is formed continues to dissolve. The result will be an aqueous solution of chloride of lead, which can be decanted off from the residual oxide, etc. An additional quantity of water may then be added, and more muriatic acid gradually added as before, until no residuum is left, when the conversion into chloride is complete. Another method is to precipitate solutions of lead salts—acetate or nitrate, for example—by the addition of muriatic acid or of common salt. The first named of these salts is a cheap commercial product, and the second can be made by dissolving metallic lead or its oxides in nitric acid. Another method is to heat to boiling a quantity of finely powdered galena (sulphide of lead) with concentrated muriatic acid, whereby chloride of lead will be formed with the evolution of sulphuretted hydrogen. Either of these methods of procedure would, we think, be preferable to that proposed by our correspondent.

(2711) Artesian Wells.—We can give this inquirer no encouragement as to the practicability of his idea. The sinking of artesian wells is an expensive process, and is nearly always attended with risk and uncertainty as to the results obtained. It is true that in certain localities, where the character and the dip or inclination of the strata are favorable to the accumulation of water by percolation from the surface, the sinking of an artesian well can be safely undertaken, and in some localities the depth to which a well must be sunk, the quantity and pressure of water that will be obtained, and the probable cost of the work, can be figured with something like certainty. But such cases are very exceptional. The most favorable conditions are fulfilled where the strata consist of alternations of deposits permeable and impermeable to water, and where the disposition of the strata is such as to form a natural basin. Under such conditions, the rain which falls upon a pervious stratum at its outcroppings, percolates through it until its downward progress is checked by the impervious stratum below it, and it accumulates until the pervious stratum is completely saturated. The impervious stratum, therefore, acts as the floor or bottom of a vast subterranean reservoir, and the water will rise until the porous stratum is saturated and can absorb no more. Under such conditions, a well sunk a sufficient depth to penetrate the pervious stratum, will give an abundant supply of water, and the pressure under which it will be delivered will depend upon the amount of saturation of the pervious stratum and the hight of its outcropping above the surface level of the well. One of the best illustrations of such conditions as we have here described, is afforded by the "London Basin," reference to which A. H. L. will be able to make in any well provided library. In regions, however, of older, and especially of crystalline rocks, like gneisses or granites, the conditions are highly uncertain, for these rocks are so frequently fissured, distorted or disturbed by fault or shifts, that no one can predict what the experiment of sinking a well will cost, or what the result will be. We have been informed that in a case in the city of Chicago, where there are two artesian wells close together, the machinery for boring the second one was driven by a wheel propelled by the water from the first. But, as our inquirer must infer from our explanations, the subject is surrounded by too many uncertainties to justify the practicability of his idea.

(2712) Mechanical Terms.—The "pitch" of a plane is the angle at which the blade is inclined to the sole. This inclination is greater in hard-wood than in soft-wood planes. Some of the hard-wood planes have their irons so nearly erect that their action may be called scraping rather than cutting. The "set" of a saw is the slightly increased width given to its toothed edge by alternately bending the teeth towards the opposite sides of the blade; the extent to which this is done, or the width of the "set," therefore, determines the amount of material which a saw wastes in making its cut; the more perfect its action the smaller being the amount of "set" required to make it work freely, and the less the power expended in working it. Grimshaw defines "setting" to be the bending of the teeth laterally, alternately to the right and left, partly with a view to decreasing friction and increasing clearance, and partly to increase the cutting action of the teeth, and make them *cut* rather than *abrade*. *Swaging* is another operation having the same objects—giving clearance, preventing binding and heating, and giving increased keenness to the teeth. In this operation, which differs therefore from "setting," each tooth is upset, or widened, at its point, so as to project beyond the blade at each side.

(2713) Sheet Metal for Pressing.—The object for which the metal is to be used not having been stated by H. K., we are obliged to answer the question literally as he puts it. Sheet zinc is much more pliable than sheet iron, plain or galvanized, and the difference in cost is trifling. There are likewise a number of composition metals, much in vogue for roofing and other uses, and which most probably contain considerable lead. They are very pliable, and would answer our correspondent's purpose in that particular, and their cost cannot be much greater than that of iron. By making a few inquiries, H. K. will have no difficulty in getting samples and prices of some of these compositions.

(2714) Lever Problem.—On the supposition that the bar is of uniform density and thickness throughout its entire length, the following procedure gives a solution of the question asked: Let x=the distance of the fulcrum from the extremity to which the weight is attached. The 60 pounds act with the lever arm x. The weight of that part of the lever, x, acts with a lever arm equal to the distance of its center of gravity from the fulcrum, or $\frac{x}{2}$. These two forces are balanced by the weight of the part of the lever equal to (84 ins.$-x$) in length, which acts with a lever arm of $\frac{84-x}{2}$.

Let the weight of the lever x=P; the weight of the entire lever=40 pounds; then will the weight of the lever $(84-x)=40-P$. And the equation of equilibrium will be

$$60x+P\frac{x}{2}=(40-P)\left\{\frac{84-x}{2}\right\};\ \text{or}$$

$$x\left\{60+\frac{P}{2}\right\}=1680-20x-42P+\frac{Px}{2},$$

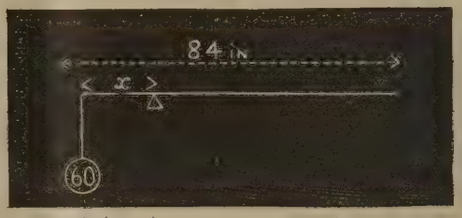
which, when collected and reduced, gives

$$80x=1680-42P;\ \text{or},\ x=\frac{1680-42P}{80}\quad(1).$$

But the weight $P=\frac{40}{84}x=\frac{10}{21}x$, which value substituted in equation (1) gives

$x=21-\frac{5}{4}x$, or $\frac{5}{4}x=21$; from which $x=16.8$ inches, which is the required answer.

Or perhaps a more direct and quicker form of solution would



be the following: Starting with equation $80x=1680-42P$ (1) substitute value of $P=\frac{10}{21}x$ in (1), which gives us $100x=1680$, from which $x=16.8$, the required answer.

(2715) Removing Stains from Bricks.—The porous nature of bricks commonly used in building, allows of the incorporation of the finest particles of dust and dirt into the texture of the brick itself. The removal of such stains, caused by black mortar and dust, appears to be out of the question. The only remedy, is the one generally adopted—of painting brick fronts when they have become so soiled and dingy as to be an eyesore. The general substitution of vitrified or enamelled bricks for the porous surfaced bricks commonly used, would obviate this trouble, since dust and dirt will not adhere to their smooth surfaces.

(2716) Boiler-Setting.—This correspondent will find an excellent article on furnace and boiler setting in Barr's "Practical Treatise on Steam Boilers, [which we can furnish postpaid for $4], in which he will also find a full description, illustrated with sectional views, of the Jarvis furnace-setting. We shall bear in mind the suggestion of our correspondent to discuss the subject of boiler-setting, and may find an early opportunity to do so in our columns.

(2717) Artificial Black Walnut.—Our correspondent may find the following recipe to answer his purpose. It is said to be much used in Europe for that purpose. By this procedure, it is claimed, ordinary white woods have imparted to them the appearance of the most beautiful specimens of walnut, and are adapted to the finest cabinet-work. With this last statement we are disposed to disagree, since we hold that no imitation can ever perfectly substitute the real thing, and should not therefore be used for the finest class of work. The procedure is as follows: The wood, first thoroughly dried and warmed, is coated once or twice with a strong aqueous solution of extract of walnut peel. When half dried, the wood thus treated is brushed with a solution compound of 1 part (by weight) of bichromate of potassa in 5 parts of boiling water; and after drying thoroughly, is rubbed and polished. By this treatment, the color is said to be fixed in the wood to the depth of one-12th to one-6th of an inch, and in the majority of cases the walnut appearance is declared to be very perfectly imitated.

(2718) Why a Pump will not Lift Hot Water.—The suction pump depends for its action on atmospheric pressure. When the piston of such a pump is raised, a vacuum is formed beneath it, and the water from the well or reservoir is forced to follow the piston up to the top of its stroke, by the atmospheric pressure on the water surface with which the pump is connected. When the attempt is made to lift very hot water, however, the rise of the piston causes an abundant evolution of steam or vapor from the water surface, which fills the space beneath the piston. This steam or vapor has considerable tension, and exerts a sufficient back pressure to counterbalance and equalize the atmospheric pressure. On this account, the lifting of hot water, save for very small lifts, is impossible. When hot liquids are to be pumped, therefore, the point of supply should not be below the pump, but rather a little above it, so that the liquid may flow into it.

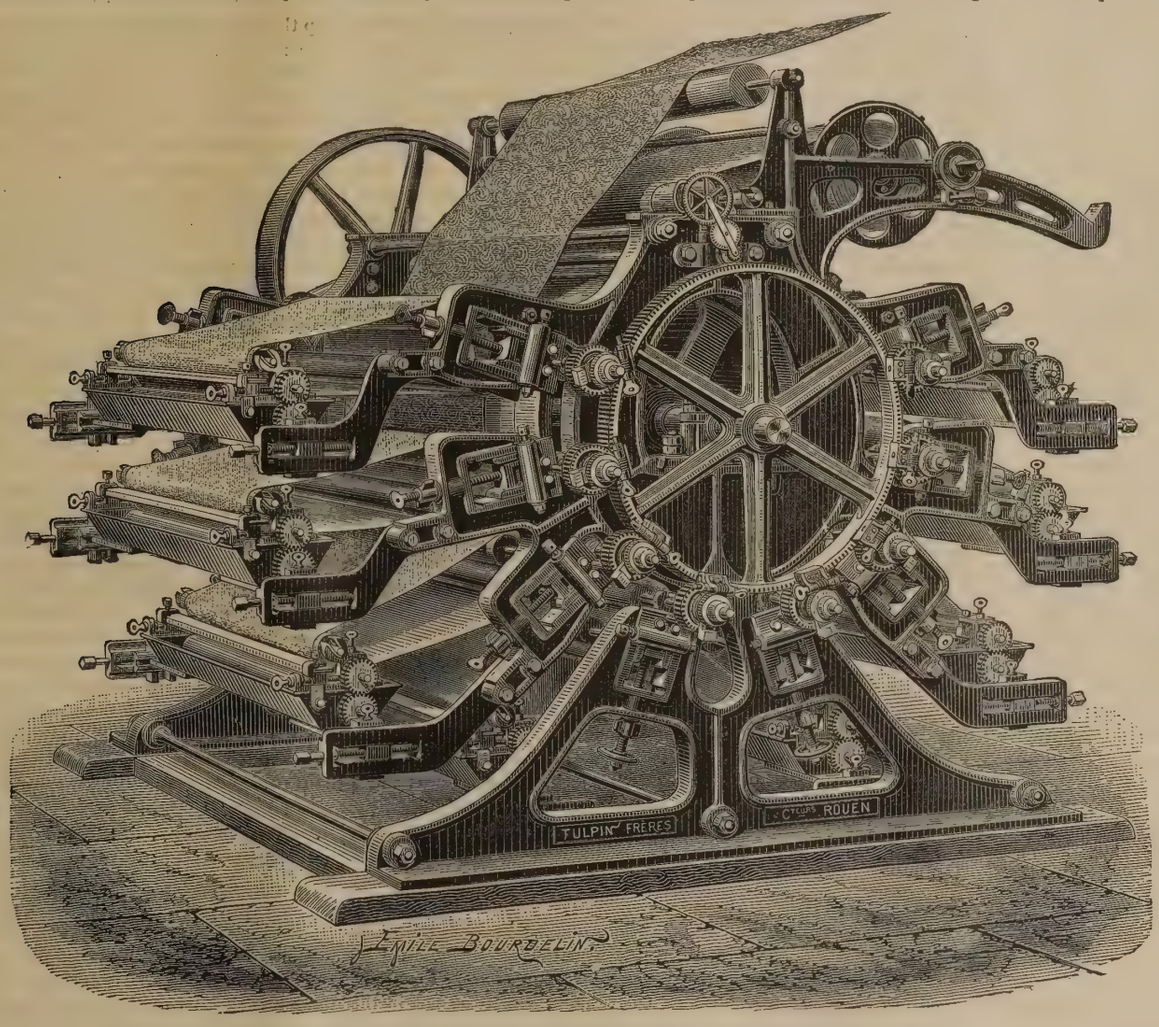
THE MANUFACTURER AND BUILDER.

Vol. XII.—No. 12. DECEMBER, 1880. TWELFTH YEAR.

Wall-Paper Printing Machine.

We illustrate herewith a very elaborate special machine designed for color-printing wall-papers. The manufacture of wall-paper has rapidly grown during the past few years, owing to its greatly increased consumption, and both the methods of manufacture and the quality of the products have of late been very much improved.

The special machine here illustrated is made by the Tulpin Brothers, of Rouen, France, who have designed a number of machines to be used in this branch of industry, and which have been extensively introduced in Europe. The machines that have acquired special reputation, are intended for grounding, sizing, color-printing, and satining. We have only space to illustrate and describe their color printing-press, for the use of which we are indebted to our neighbor *Der Techniker*.



COLOR PRINTING-PRESS FOR WALL-PAPER.

In the operation of color-printing, it is necessary, of course, to have as many engraved patterns as there are colors to be printed. In the press these patterns are engraved upon cylindrical rollers, and the roll of paper to be printed is passed around a large drum, coming, in the course of its travel, in contact with the revolving rollers, one after the other, each roller being supplied with its own pigment by suitable rollers having endless traveling aprons dipping in troughs containing the colors. The machine, as will be observed, has a general resemblance to the presses used in calico-printing. The paper is fed continuously from a large roll, seen at the top of the machine, and, being kept sufficiently taut by a simple device, is passed around the large drum. The face of the drum is covered with cloth, and in its passage around it the paper receives, one after the other, the impression from the engraved rollers. The color is fed to each of the design rollers by means of an endless apron, as seen in the engraving, passing about special rollers, each dipping in a trough of its appropriate color, and driven by suitable gearing. When the paper has passed about the circumference of the drum, it has received the impression of all the rollers, which, according to the number of colors required, may be as high as eight or twelve in number. In the machine here shown, there are eight. After the paper has passed the last roller, it is passed on to a drying machine. To produce good work, these machines require to be accurately and substantially constructed, and in these respects the machines of Tulpin Brothers have acquired a well-earned reputation. The frame of the machine here shown is very solid, so that notwithstanding its high speed (3,000 rolls per day), its action is not attended with notable shocks or vibrations. The driving mechanism works smoothly, all parts are readily accessible, and the design rollers easily removable.

We may illustrate other machines of this special class in a future issue.

The Oleomargarine Industry is assuming enormous proportions. The Bureau of Statistics reports that for the present year ended June 30, 1880, there were exported from the port of New York:

	Pounds.	Value.
Butter	31,061,010	$5,169,071
Oleomargarine	19,883,330	2,581,317

It will not be long, at this rate, before the export of artificial butter will exceed that of the natural product in quantity and value.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XII. No. 12. TWELFTH YEAR.

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Renewal of Subscriptions.

A large number of subscriptions to the MANUFACTURER AND BUILDER expire with the present number, and we would request that subscribers send in their renewals promptly, so as to avoid any delay attendant upon receiving the following issues.

An Unrighteous Verdict.

The recent verdict of a Philadelphia jury in the suit of the widow of Engineer Deitel against the Hartford Steam Boiler Inspection and Insurance Company, for pecuniary damages, on the charge that the company was responsible for his death, by reason of careless inspection, which eventually caused the explosion by which Deitel lost his life, raises the question whether corporations have any rights that juries are bound to respect. The evidence presented in this case, which we followed with special interest, signally failed to show the slightest ground upon which the charge of negligence on the company's part could be based. On the contrary, the testimony elicited at the trial established beyond reasonable doubt the following facts: First, that the inspection by the company had been unusually painstaking and thorough; second, that the boiler had been so seriously injured by careless management after the company's inspection, that it had been necessary to call in a boiler-maker to repair it on two occasions; and third, that the company's officers had not been notified of any trouble with the boiler, and knew nothing of the tinkering that had been done, until after the explosion. In the face of these facts, all of which were clearly brought out in the trial, the jury gave the widow substantial damages, and constructively found the company censurable for neglect of duty.

We give below a brief summary of the leading facts of the case, from which our readers will be able to judge for themselves of the truth of the charge that we feel constrained to make—that the jury permitted themselves to be influenced by the sentimental consideration of sympathy for the widow, to commit an act of gross injustice against the Hartford company.

The facts are these: The company had insured the boiler of Messrs. Wilt & Son for nine years, or from the time it was put up until it exploded. It was of the type known as the "double decker"—that is, a 54-inch diameter boiler, filled with tubes. These were 73 in number, each 3½ inches in diameter. This boiler was connected to an upper cylinder by four necks. It belonged to a class of boilers very common in Philadelphia, where there are probably 350 or 400 in use at the present time. It was built of scant ⅝-inch iron, "C. H. No 1" brand, and was made at the People's Works, an establishment well known for its superior work in the line of boilers and engines. It was single riveted in its long horizontal seams, and when new, under the United States tables of maximum pressures, was safe at 115 pounds per square inch. But the policy of insurance allowed only 90 pounds at first, and subsequently only 80 pounds. Near the close of December, 1878, the company's inspector called at the works of Wilt & Son to inspect the boiler. During this inspection, he found a blister on one of the fire sheets and recommended a new half sheet to be put in the place of the one damaged. This was done, and on the 3d of January, 1879, the inspector again visited the place to see that the work had been well done. The tubes had all been removed from the boiler, and new ones were to be put in. The shell repairs were all completed, and, with the tubes out, unusual facilities were afforded for a very thorough examination. The inspector was in the boiler for more than an hour with the engineer and boiler-maker. Every seam was carefully examined, and the inspection was as complete and thorough as it could have been.

The Philadelphia city ordinances require a hydrostatic test of boilers. This of course was impossible at the visit just mentioned, as the tubes were not in; but after they were in place, and the boiler had been run a short time, the hydrostatic test was applied by the inspector and his assistant, and while the pressure was on, careful examination was made for leaks at the seams or about the heads. The engineer was present and assisted. The boiler was found to be tight and in good condition, and a certificate for 80 pounds was granted.

On the 9th of June following, the engineer noticed that the boiler was leaking about the tubes, and sent for a boiler-maker to calk it. The boiler-maker said he had had the water low and burned the boiler; but this was denied by the engineer, who said he was forcing it all he could. The tubes were repaired, and on the 16th of June, just a week later, new leakage was discovered, and the boiler-maker was called again. He said, as before, that there must have been low water, and that the boiler was burned, and received the same explanation as before. All this time the Hartford company had not been notified that there was anything wrong.

On June 26th, a brother engineer called and found the boiler in a very bad condition, leaking at the tubes, and told the engineer that it was not safe for him to run that boiler another hour, and advised stopping at once. Deitel made answer that he could not stop then, and must run on to July 4th, when he could have repairs made. He had himself stated to more than one person that he was afraid of the boiler. On the morning of the next day, June 27th, the boiler exploded, and the engineer was killed. The news of the disaster was the first intimation the company had received that anything was wrong.

From this statement of facts, we feel confident that our readers will concur with us in the opinion that we expressed at the outset of this criticism—that the verdict of the jury in this case was an unrighteous one. Had the plaintiff succeeded in presenting a case which would have made it possible to cast a doubt upon the thoroughness of the company's inspection, or the competency of the company's officials, we should have applauded a verdict for exemplary damages. But not an iota of such testimony was substantiated. It must not be forgotten that corporations have rights which have as substantial a claim for just consideration at the hands of jurymen as those of individuals, and we know of no similar instance wherein a more glaring infraction of justice has been practiced than in this one.

The erratic findings of jurymen in numberless cases, have awakened in the minds of many thinking persons the grave suspicion that trial by jury is often little better than a farce. The outcome of this case teaches, perhaps, another lesson—namely, that jurors who are required to pass upon the merits of cases involving an intimate familiarity with technical matters relating to the use of steam machinery, should be expected to possess some acquaintance with the subject, and should on that account be selected from the number of those whose business or professional pursuits would imply the possession of such knowledge. The "twelve good men and true" who figured in the case we are criticizing, had the following occupations, to wit: One chair-maker, two printers, one plumber, one saw-maker, one paper-hanger, one agent, one dealer (in old iron, etc.,) one cigar-stand keeper, one furnisher, one painter, and one laborer. From the constitution of this jury, we think it is an open question if a single member of it was really able to comprehend the merits of the case, for the want of the necessary technical knowledge.

It will scarcely be necessary to add, in conclusion, that the company have appealed the case, and as they are clearly in the right, they propose to exhaust every legal remedy to secure a reversal of an unjust verdict.

The Sewerage Improvements of Boston.

The city of Boston deserves the distinction of being the first great American city whose authorities seem to have grappled with the serious problem of sewerage in something like an intelligent manner, by the adoption of what may with propriety be called a *system* of sewerage. Other American cities have, what by li-

cense of speech, are called sewerage systems in operation, but we may safely say that none are really deserving of the name. In view of the exceptionally rapid growth of our leading cities, the pressing necessities of the present have hitherto been too imperative to permit of the elaboration and carrying into execution of comprehensive and intelligent methods. But the time is now ripe for such reforms, and Boston gives evidence of the intelligence that has always distinguished her, by being the first of our great cities to adopt a system of sewerage that promises to protect the health of her citizens.

We give in what follows a brief description of the general plan adopted in that city, from the accounts that have been published concerning it. It comprises a system of low intercepting sewers along the margins of the city, which communicate with and receive the discharges of the already existing sewers. These intercepting sewers in turn communicate with and discharge into a main sewer, which crosses the city and terminates at a pumping station located on the seacoast. Here pumping machinery is provided which raises the sewage to a hight of 35 feet, and to the level of an outlet sewer, partly in tunnel, which leads from a pumping station to a reservoir at Moon Island, in the harbor. From this reservoir, the sewage which has accumulated during the latter part of the ebb, and during the whole of the flood tide, will be discharged into the harbor during the first two hours of the ebb tide. This reservoir is to cover five acres, and will be emptied just after each period of high tide, at which time the currents setting seaward from the island are expected to carry the sewage well out to sea, and so far beyond the harbor as to prevent any possibility of its return.

In carrying out these details, some fourteen miles of mains and intercepting sewers, besides the other works above named, will require to be constructed. At the present time the undertaking is well under way, something like eight miles of sewer having been completed. It is anticipated that it will take about three years yet to complete the works as here described. Their cost will be $4,000,000.

From the foregoing account, it will be perceived that the city of Boston will have, when the works now in course of construction are completed and in operation, a very complete and intelligent system for the disposal of its sewage, and which cannot but have a most beneficial influence on the health of her population. We commend the example of Boston to the careful consideration of the authorities of other cities as an excellent one to imitate in its general features.

The New York Underground Railway.

Public announcements have lately been made that at length a strong organization has been formed to carry into execution the long-talked of and much-debated project of an underground railway in Broadway. The name of the association is the New York Underground Railway Company, and it is from the designs of Mr. Walter J. Morris, their chief engineer, that the road is proposed to be constructed.

On the authority of numerous articles that have appeared in the newspapers concerning the scheme, we learn that the road will have a length of seven miles. It is proposed to start it from the South Ferry, whence it will extend along the eastern side of the Battery to Broadway and Bowling Green, thence up Broadway under Union Square to Madison Square, thence to 42d street, and lastly to Harlem. The intention of the company, as announced, is, if possible, to make connection at 42d street with the New York Central Railroad for the remaining distance; but should this plan not succeed, they propose to continue the road underground until 100th street is reached, from which point an elevated road will be built to Harlem. In the lower part of the city one or more cross roads are contemplated, to extend from river to river. These are primarily designed for the transfer of freight, and should they prove remunerative, others will be built further up town as they seem to be required. The movers of these projects anticipate their completion by the spring of 1883.

The plan of the underground railway that is said to have been decided upon, contemplates two parallel single track tunnels, each 12 feet 7 inches wide in the clear, and 15 feet high from the top of the rail to the crown of the arch. The tunnels will have vertical side walls, with two similar 3-center arches resting on a dividing wall. When a firm foundation shall have been secured, a bed of concrete will be laid, in which the inverts will be placed to hold the walls. The thickness of the tunnel walls will vary according to situation and the character of the soil; that of the dividing wall will be about 3 feet. It will be provided at intervals of 20 or 30 feet with iron doors or shutters. The outer surface of the tunnel will be covered with a good layer of asphalt, to render the work impervious to moisture, and the interior will be smoothly coated with a hard white finish.

The work will be built at sufficient depth below the street level to avoid the gas and water pipes, and the sewers that are met with will be reconstructed by the company. The tracks will be of standard gauge, and will rest on creosoted cross-ties. The cars will be of two classes, some with doors opening in the sides, and others with doors in the ends. The foundations of the tunnels will be sufficiently strong, it is claimed, to allow of the use of powerful engines. The engines will be of special pattern, and constructed to consume their own smoke and to condense their own steam. At the stations, which will be numerous, air shafts one hundred feet in hight will be placed, with others extending only to the ground surface at intervals between them. By these devices, and by providing the locomotives with a projecting flange about the pilot-house, so as to cause them to force out a volume of air in advance of the trains, and thus draw in a supply behind them, it is anticipated that the ventilation of the tunnel will be satisfactorily maintained. The lighting of the stations, cars and tunnels, it is said, will be by electricity.

The following points are named for the location of stations: South Ferry, Wall street, City Hall Park, Leonard street, Prince street, Astor Place, Union Park, Madison Square, 34th street, 42d street, 51st and 59th streets, and on Madison avenue at 34th and 42d streets.

It is reported that the company organized for this work have secured ample privileges for the purpose, and that the funds required for its execution have been secured chiefly in Europe. The latest statement respecting this portion of the subject being that the franchises of a company already in existence have passed into the control of the New York Underground Railway Company.

It is estimated that on the plan above briefly outlined, the cost of the road, equipped and ready for traffic, will not be less than $2,500,000 per mile.

We are convinced, from the experience of London, that the underground system offers the only and final solution of the problem of rapid transit in populous cities.

The Tariff and the Cobden Club.

An agent of the Cobden Club is lately reported to have said: "If we do not succeed in getting your tariff removed, we will have to retaliate and put a duty on the cheese, butter and beef that America is shipping to us." Is there any one idiotic enough to believe that England is doing *us* a favor by taking from us the necessaries of life, without which her people would starve? Or is there one so foolish as to imagine for one moment that she would take a shilling's worth of our cheese, or butter, or beef, if she could help herself? The threat implied in the above utterance is too childish for serious consideration. The thing that troubles the philanthropists of the Cobden Club, is that they must pay for a goodly share of what they buy of us, in hard cash, and that they cannot settle the account in trade.

Food Adulteration in the United States.

On this subject, which has been the theme of a great deal of sensational writing during the past few years, Prof. S. W. Johnson, of Yale, than whom none are more competent to pass an opinion, lately read a valuable paper before the meeting of American Social Science Association, at Saratoga, which our readers will find published in another part of this journal. After giving a lengthy account of the various methods of food adulteration as practiced abroad and at home, and the means adopted to check the evil, the author comes to the question that most concerns us, namely, "Are we, in the United States, liable to suffer in purse and health from the adulterations that are now practiced upon our food?" This question he answers qualifiedly in the negative. His statement of the condition of things is about as follows: Generally speaking, we are not suffering serious loss of goods or of health. This answer he justifies by reference to official and other investigations that have been made in New York, Boston and other large cities, and which have not revealed very widespread or injurious adulterations, except in the case of milk, baking powders, and a few other articles. He adds that his own examinations of staple articles sold in the city of New Haven, have failed to disclose any deleterious or extensive tampering with food, except in the case of coffee, mustard and pickles, and in these instances but little harm is done, since it rarely happens that those who demand a good article and are willing to pay a fair price, fail to get what is genuine and wholesome.

He bestows a well merited rebuke upon those alarmists who would have us believe that we are being defrauded and poisoned in a wholesale way on every hand, and exposes some of the gross exaggerations that have been extensively disseminated in the newspapers respecting this subject. Finally, he urges upon State and municipal authorities the duty of framing and enforcing such wise laws as shall confine food adulteration to the very narrowest limits. He argues for a comprehensive statute that shall apply to all adulterations and falsifications. This should plainly define what constitutes genuine legal milk, bread, mustard, etc. It should provide for the employment of competent public analysts, trained in chemical analysis and microscopy, to examine and test any article that may be submitted to them for that purpose. Such tests should be made for any person bringing samples under suitable regulations, at a very moderate charge; and it should be provided that any article on sale of suspicious or doubtful character, should be liable to be analyzed at any time at public expense, so that the poor, who can rarely afford the cost of such tests, may nevertheless participate in the benefits of the law. He refers in this connection to the British "Sales of Food and Drugs Act," as amended in 1875, and which provides for the appointment of public analysts in the various cities, counties, districts and boroughs, and for the inspection and testing of food by and under the direction of suitable officers, and at public cost, as well as for making tests for individuals at a small charge. The Society of Public Analysts, which has grown out of the operations of this act, he states, has proved itself highly useful, and exercises a wholesome influence on the health, comfort and conscience of the British public.

The establishment of one public food-testing laboratory in each State, coöperating with the State Boards of Health, he holds, would annually save the citizens many times the cost of its maintenance, just as the agricultural stations now save the farmers immense sums by protecting them against the falsification of fertilizers.

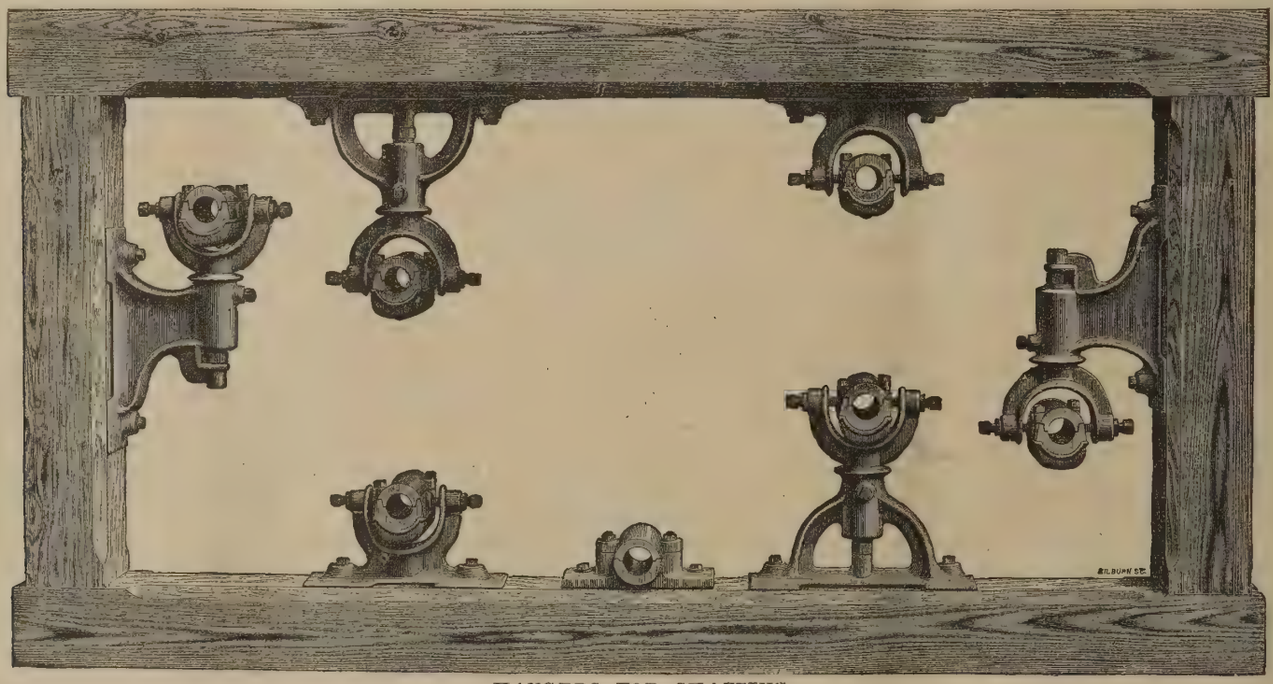
The English Channel Tunnel.

The borings at Sangatte, the point of departure on the French side for the proposed English Channel tunnel, are reported to have reached a depth of nearly 200 feet, or about 180 feet below the level of high water.

The shaft has a width of 10 feet, and is lined with oak. Only a small quantity of water finds its way into the shaft, and this is fresh, a fact which is held to prove that the layers hitherto traversed have their points of contact sufficiently far from the shore to prevent the infiltration of sea water. When a depth of 300 feet has been reached, it is intended to excavate a gallery beneath the channel. The practicability of the tunnel, from an engineering standpoint, will depend on the absence of irregularities or fissures in the strata beneath the bed of the channel, which, it would appear, can only be positively determined by driving an experimental gallery all the way across.

Self-Oiling and Self-Adjusting Hangers for Shafting.

The proper hanging and care of shafting is a consideration of prime importance in every establishment where power is used, for upon these elements the proportion of power available for use, as compared with the amount generated, will largely depend. The good mechanic will see that his line of shafting runs true, that the pulleys do not wobble, and that the line runs smoothly and noiselessly. When these conditions are fulfilled, the percentage of lost power between the prime mover and the working machinery is reduced to as low a figure as it is practicable to attain. In the elimination of this item of waste, perhaps as much depends upon the selection of properly constructed hangers as in the competency of the mechanic who puts them in place.



HANGERS FOR SHAFTING.

We exhibit in the accompanying engraving a very simple and compact form of hanger, capable, by simple modification, of meeting all the requirements of practice. They are self-adjusting and self-oiling, and, as may be observed from an inspection of the cut, can be used with either side up, as the sustaining bolt in the yoke supports the load in either direction. They are neat in appearance, strong and cheap, and by reason of their excellent adaptability to the practical requirements of the shop, have secured a very general introduction.

Further information respecting these hangers will be furnished by the George Place Machinery Agency, 121 Chambers street, New York.

Report on the Tay Bridge Disaster.

The commissioners appointed to investigate the causes of the Tay bridge disaster, which will still be fresh in the memories of our readers, employed Mr. Henry Law, member of the Institute of Civil Engineers, to examine the bridge after its fall, and to make a report thereon which could be used afterwards as evidence in subsequent legal proceedings. Mr. Law made the examination, and has just presented a lengthy report of his investigations, from which we make the following summary of his conclusions:

He finds that the base of the pier was too narrow, occasioning a very great strain upon the struts and ties; that the angles at which the latter were disposed, and the mode of connecting them to the columns, were such as to render them of little or no use; and that other imperfections, which he points out, lessened the power of the columns to resist a crushing strain; and further, that the yielding of the struts and ties was the immediate cause of the disaster. Among the other imperfections alluded to above, one was the defective mode of connecting the columns at the flange joints, the bolts being one-eighth inch less in diameter than the hole, and the flanges being separated in some places as much as three-quarters of an inch. The mode of attaching the ties to the columns by means of lugs, he held to be insufficient, as in every instance it was found that the lugs were torn away. Finally, he condemns the concrete used in the structure as bad.

Assuming the correctness of Mr. Law's strictures, in the face of so many faults in design, construction and selection of materials, the wonder is, not that the bridge gave way as it did and when it did, but rather how it was ever coaxed to stand alone.

The Future of the Bessemer Process.

In concluding a report of an official Austrian commission, appointed to investigate the merits of the Thomas-Gilchrist process of working phosphoretic pig iron, the well-known metallurgist, Peter von Tunner, after referring to the great importance of the fact that the Bessemer converter may now be used for the treatment of almost any kind of pig-iron, concludes that the Bessemer process will, in the near future, become the prevailing process everywhere for the production of malleable iron, as it now is for steel. He holds that the extinction of puddling works, especially of those engaged in the production of weld-iron, by the growth of the production of ingot-iron by the Thomas-Gilchrist process, is imminent.

THE ST. GOTHARD TUNNEL, which, when all the lines of approach are finally completed next summer, will be opened for traffic, will form the shortest line of transit between the valley of the Rhine and the Mediterranean; and it has been well said that when the geographical relations of the countries it serves to connect are considered, together with the vast political, military and commercial interests which will be affected by it, it may safely be characterized as the great artery of European international life and circulation, and as the most important work of material improvement yet projected on the European continent.

American vs. Foreign Saws.

There is a great variety of opinions regarding the different "makes" of hand-saws among workmen. Some excellent workmen seem to think that the best saws are imported from England, while other equally excellent workmen would not use an English saw where it was possible to obtain one made by some reliable American firm. This difference of opinion is mainly attributable to circumstances not at all connected with the question of quality. Imported workmen, as a rule, prefer imported tools. Few native American workmen care to use the clumsy tools that were handled by their fathers, when the handier, more complete, and certainly more efficient ones of American manufacture are to be had for less money. It may be true, though we doubt it, that some saws of English manufacture may possess certain points of excellence that are not found in the productions of our own makers; but if such exist, they are more than negatived by their clumsy construction and non-adaptation to American wants. For handiness, beauty of finish, adaptability and efficiency, the American saws excel all others; and these qualities are not only known to those who have tried them, but also to many workmen who have been accustomed to the use of saws of European manufacture. Saws of American make are found side by side with the best English brands in all portions of the civilized world, and in many countries are preferred to the latter by native workmen. The adoption of our saws by foreigners, in preference to those made in Europe, is, after all, perhaps the best test of their superior qualities on the whole, as the stranger is not likely to be influenced by national prejudices when making a selection.

IT IS PROPOSED TO UTILIZE THE SWIFT CURRENTS OF RIVERS by systems of anchored floats carrying current wheels connected with dynamo-electric machines. The electricity thus generated might be conveyed to factories on the shores and set to work by means of electro motors; or it might be used for lighting towns, or even for running trains on railways.

Metallic Shingles for Roofing.

We invite the attention of our readers to the following description of the improved metallic roofing manufactured by the Iron-Clad Manufacturing Company, of 22 Cliff street, New York, of which occasional notices have appeared in our earlier issues. We may allude, as preliminary to this description, to the statement that we have already taken occasion to make, that an iron roof, when properly laid down, has many points of superiority over other kinds of roofing, for reasons which we shall give in detail further on.

Fig. 1 represents the form of shingle used by the above named company; and the method of laying the same and the appearance of it when laid, is shown in Fig. 2. Referring to these cuts, we may add that the size of each shingle is $8^{7}/_{16} \times 16$ inches. When laid, each shingle engages with its neighbors, overlapping in such a manner as to form a double metallic lining, and the manner in which the shingles engage is such as to form a strong and durable connection. This will be better understood by the statement that the point E, Fig. 1, of each shingle is held firmly and tightly to its place by passing under the slots H H of the members of the next course below. The corrugations B B, by fitting closely under the corrugations A A of the next course above, the corrugations G G, by fitting under the corrugations B B of the next course above, and the sides F F being turned up so as to fit under the central rib or corrugation D of the course above, make a thoroughly storm-proof roof and form a covering of two thicknesses of iron. In laying the shingles, the nail-holes F F come exactly over the upper nail-holes of the course below. They are easily laid by any carpenter, being simply what the name indicates—metallic slates or shingles—to be laid in courses the same as ordinary slates or wood shingles. For the first or eaves course, the makers furnish the "short" shingles, which are simply the regular shingles with the points cut off, so as to make an even edge.

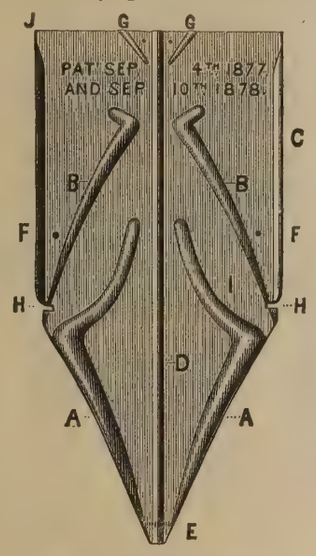


Fig. 1.—Metallic Shingle.

The manner of laying the shingles will be understood from the reading of the following description, reference being had to Fig. 2. First, draw the line A A at the correct distance from the eaves, to lay on it the upper holes of the eaves course of the shingles. Obtain the center of this line, and draw from it the perpendicular line C C to the ridge of the roof. From the intersection of these lines at C, measure say 6 feet on the horizontal line A A; then also from the intersection of the lines measure 8 feet up on the line C C, and at that point draw the horizontal line B B. By taking a pole exactly 10 feet long, and applying it to the points E E, one can ascertain whether the perpendicular line C C is drawn correctly at right angles with the horizontal line A A, as, if it is, the distance from E to E will be exactly 10 feet. Then "step" off with a pair of dividers, or with a gauge constructed for the purpose, $8\frac{3}{8}$ inches each way from the line C C, and draw the perpendicular lines 1, 2, 3, 4, 5, 6, etc., at that distance apart, and exactly parallel with the line C C. These lines will show the exact width of the shingles. Also draw horizontal lines parallel with the line A A, $6\frac{1}{4}$ inches apart, on which to lay the upper nail-holes of each horizontal series. A pencil and straight-edge are the best to draw the lines with. Commence laying the "shorts" or eaves course of shingles from the line C C, taking care to have the upper nail-holes in them come exactly over the line A A; of course this line A A can be drawn so as to allow the shingles to project over the eaves as much as is desired. In laying the eaves course, and indeed all succeeding courses, care should be taken to keep the sides of each shingle straight with the perpendicular lines, and also to keep the slots in the sides of the shingles exactly opposite each other. Commence to lay the full size shingles at the line C C, placing the central rib or corrugation D exactly over the line. If the lines are drawn correctly, the nail-holes in the shingles will always exactly fit over each other, and any number of shinglers can work on the roof at the same time. In finishing at the ridge of roof, bend each shingle of the ridge course over so as to lap on the opposite side of the roof about 2 inches, nailing in the lap. In laying them on hip roofs, trim the sides or the ends of the shingles to the same angle as the hip, and bend them over the corner so as to lap on the opposite side of the roof (as at the ridge), nailing them in the lap. In laying them along valleys, trim them to the angle of the valley, and use a sheet of tin or other metal the same as with slates or wood shingles. The shingles can always be cut to the desired shapes, as above, also to make them come out even at the edge of the roof, with a pair of ordinary tinner's hand shears or "snips."

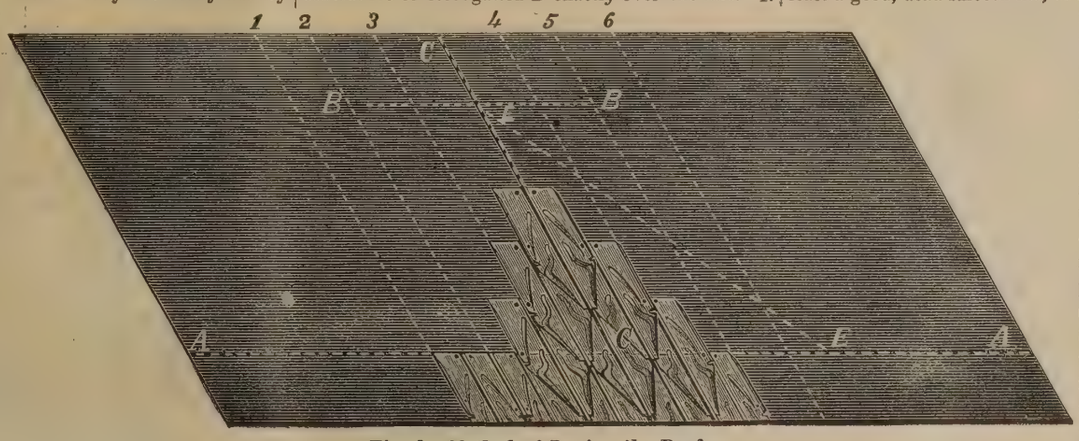


Fig. 2.—Method of Laying the Roof.

Fig. 3.—Iron Ridge Cap.

When the shingles are properly laid, the makers recommend that they be covered with the iron ridge cap shown in Fig. 3. This provides a good finish for the ridges and hips of roofs. In putting it on, it should be nailed at one end only of each length. For this purpose it is made in lengths of 2 feet, and the next piece locks into the nailed end. As compared with other roofs, the manufacturers of this form of roofing make a number of claims to superiority. As compared with slate, it is urged that the metallic shingles are much lighter, being less than one-fourth the weight of the former; also, being of wrought iron and flexible, that they can be made to accommodate themselves to the shape of the roof, and be laid much tighter than slates, making the roof more effectually storm-proof and lastly, that they are more perfectly fire-proof than slates, which, being brittle, are liable to fly to pieces when heated, and thus expose the wood-work beneath them.

As compared with tin roofs, the claim is made that the form and mode of laying these shingles provide amply for expansion and contraction; that the latter require no solder; that they are more substantial, giving a double metallic layer, and therefore less liable to injury from accidents. As compared with wood shingles, the metallic shingles will neither warp nor shrink, they are fire-proof, and more durable.

In preparing these shingles for use, the makers either paint them with a special metallic paint, by dipping them into it while hot, or protect the metal by a coating of a metallic alloy, by the process known as "calamining," a recent substitute for galvanizing, which is reported to give admirable results in protecting iron from oxidation.

For further particulars respecting this roofing, our readers are referred to the manufacturers.

Hardening and Testing.—To really test the hardness of the surface of metal, we must take a new or at least a good, dead smooth file, and apply one corner of it to a corner rather than on a flat surface of the metal to be tested, pressing the file very firmly against the work. A coarse file, even if a new one, is useless to test with. The greatest degree of hardness is obtained by plunging the red-hot steel into mercury. Steel hardened from the surface inward is hardest on the surface, while in steel that has been tempered the exterior is the softest. In the one case, because the surface was cooled in advance; in the other, because it was heated in advance. Files are hardened in the following mixture: 2 parts (by weight) of salt, 15 of rye grist, and 30 of burnt cow hoofs, all ground together and mixed with a sufficient quantity of water to make a pasty mass, with which the files are covered. When dry, they are placed in a fire. If, during the heating, the coating should drop off at certain places, the files are promptly withdrawn and the place exposed is covered with dry hoof powder. It is returned to the fire, where it is left until a temperature is reached which best suits the steel of which the file is made. Then it is plunged vertically into the bath, care being taken not to move it to the right or left, as that would cause warping. The bath is made in the following manner: 28 parts of salt are dissolved in about 5 parts of water, to which a handful of iron scale is added. The tangs are softened by being plunged into red-hot lead.

Old Countries Succombing.—A gas company has been formed for lighting Jerusalem, and a street-car company for connecting that city with the Mount of Olives is hinted at.

Siemens' Regenerative Gas Furnace for Glass Melting.

By courtesy of Dr. Siemens' American agents, Messrs. Richmond & Potts, of 119 South Fourth street, Philadelphia, we are enabled to present our readers with the following information respecting the application of the regenerative gas furnace in glass-making, which has of late decidedly advanced the manufacture of glass in European glass producing centers, and which is now just beginning to attract the attention it should long ago have received from American manufacturers.

The application of the regenerative gas furnace to the melting of glass in pots, as a substitute for grate furnaces, was made as long ago as 1861, and was attended with very satisfactory results, both in the saving of fuel and prolonging the service of the pots. These advantages were still further increased by subsequent improvements which were introduced from time to time, by which the operation was made continuous, whereby the utmost economy is realized, owing to the suppression of pots, the improvement in the quality of the product, the diminution of the wear and tear on the furnace, and reduction of the cost of plant.

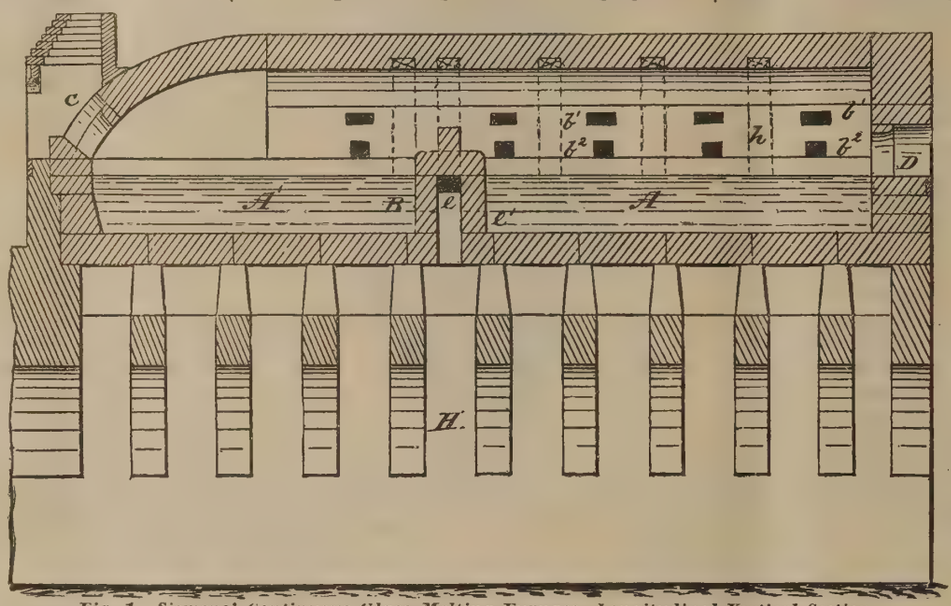


Fig. 1.—Siemens' Continuous Glass-Melting Furnace—Longitudinal Vertical Section.

The regenerative gas furnace consists of two distinct parts—the gas-producer, in which the conversion of the raw fuel (chiefly small coal) into the gaseous state is effected; and the furnace proper, with its reversing valves, regenerators, and melting or working chamber. The gas-producer is a cubical brick chamber, about 8 feet square, one side of which forms an inclined plane, to permit of the gradual descent of the fuel to the grate at the bottom, where combustion takes place. The carbonic acid gas produced by the complete combustion of the first portions of the fuel, before it can pass up the gas-collecting chamber and through the overhead tube to the furnace, encounters further layers of incandescent fuel descending from above, by contact with which it is reduced to carbonic oxide, a combustible gas, and this is also more or less charged with other combustible hydro-carbon vapors, which are evolved from the coal. The gas as it leaves the producers, therefore, consists of carbonic oxide, hydrogen, hydrocarbons, aqueous vapor, and nitrogen, which last being a constituent of the atmosphere, necessarily passes with it through the fuel, and dilutes the combustible gas produced, to the extent of about 50 per cent of the total volume. This combined gas leaves the producer at a temperature of about 700° Fah., rising in the up-take at this temperature, at which its density is about one-half of what it would possess at ordinary temperature. From the up-take the gas passes through a long tube of sheet-iron or steel, in which it parts with most of its remaining heat, so that it reaches the down-take at a temperature of about 200° Fahr. Arrived at this point, the gas has about twice the density of the ascending column, and consequently it will flow in a steady stream towards the gas furnace. By this explanation, it will be apparent that the heat lost by the gas is actually used in producing the mechanical effect of feeding itself into the furnace.

The gas, in coming from the producer as described, passes into the furnace through what is called a reversing valve, by means

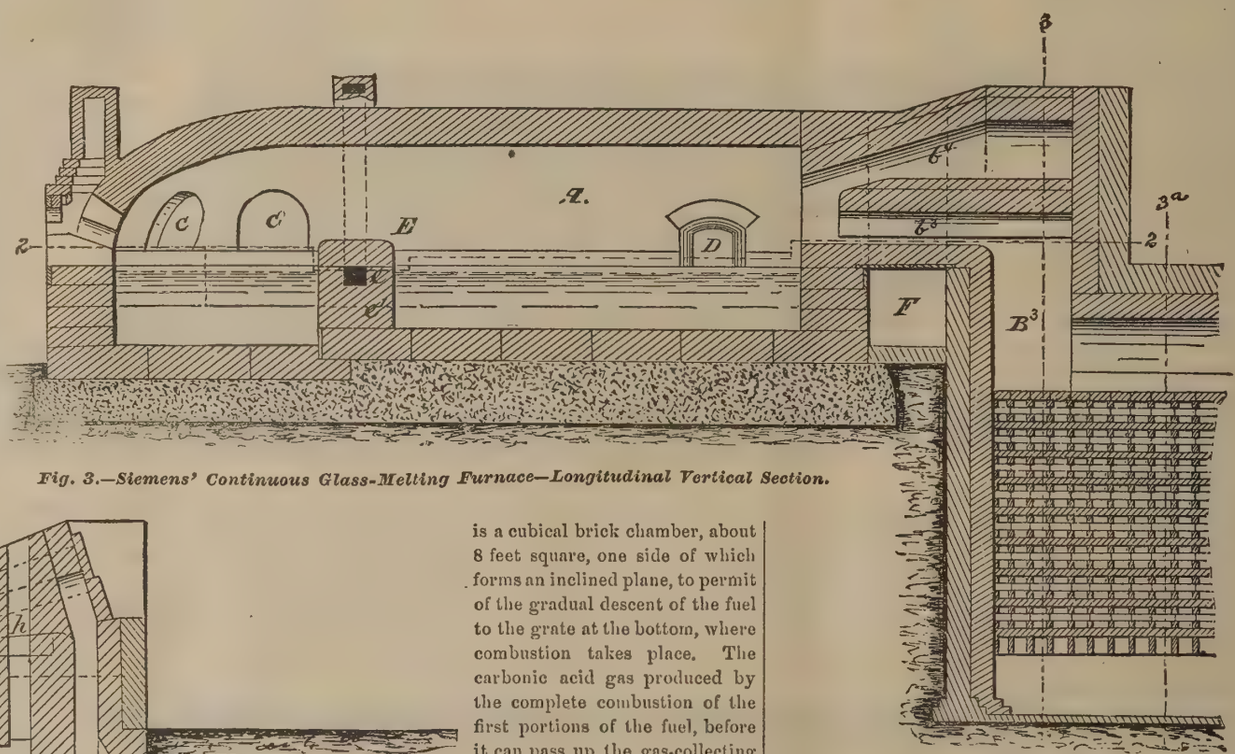


Fig. 3.—Siemens' Continuous Glass-Melting Furnace—Longitudinal Vertical Section.

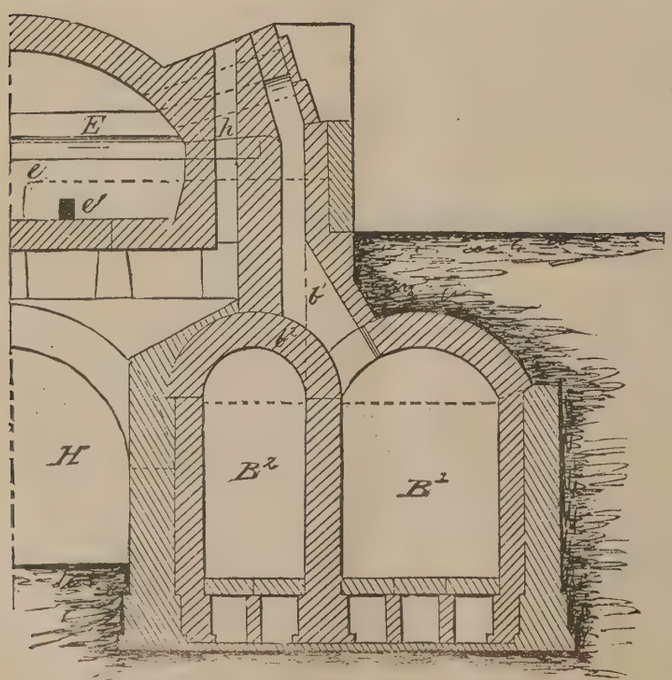


Fig. 2.—Partial Transverse Vertical Section.

of which it is directed into the bottom of the regenerative chamber. The gas flows up through a series of intricate zigzag passages in a mass of brick-work which the chamber contains, and as it reaches the entrance of the combustion chamber, meets with a current of air which is admitted through a suitable valve. As the gas and air at the outset are not heated, the heat produced by their combustion at first will be very moderate; but by an ingenious device, the flame, after passing over the bed of the furnace, does not go to the chimney direct, but is made to pass through two regenerative chambers, similar to those already described, in which passage it parts with a large amount of its heat to the contiguous brick-work, and the latter in turn to the entering air and gas, and the combustion products finally pass out at the chimney deprived of a large share of their heat.

The operation, therefore, is simply this, that the air

and combustible gas pass up into the furnace through the one pair of chambers, and pass away, after combustion, towards the chimney through the other pair; but, in passing through the second pair, the heat of the products of combustion is given up to the brick-work.

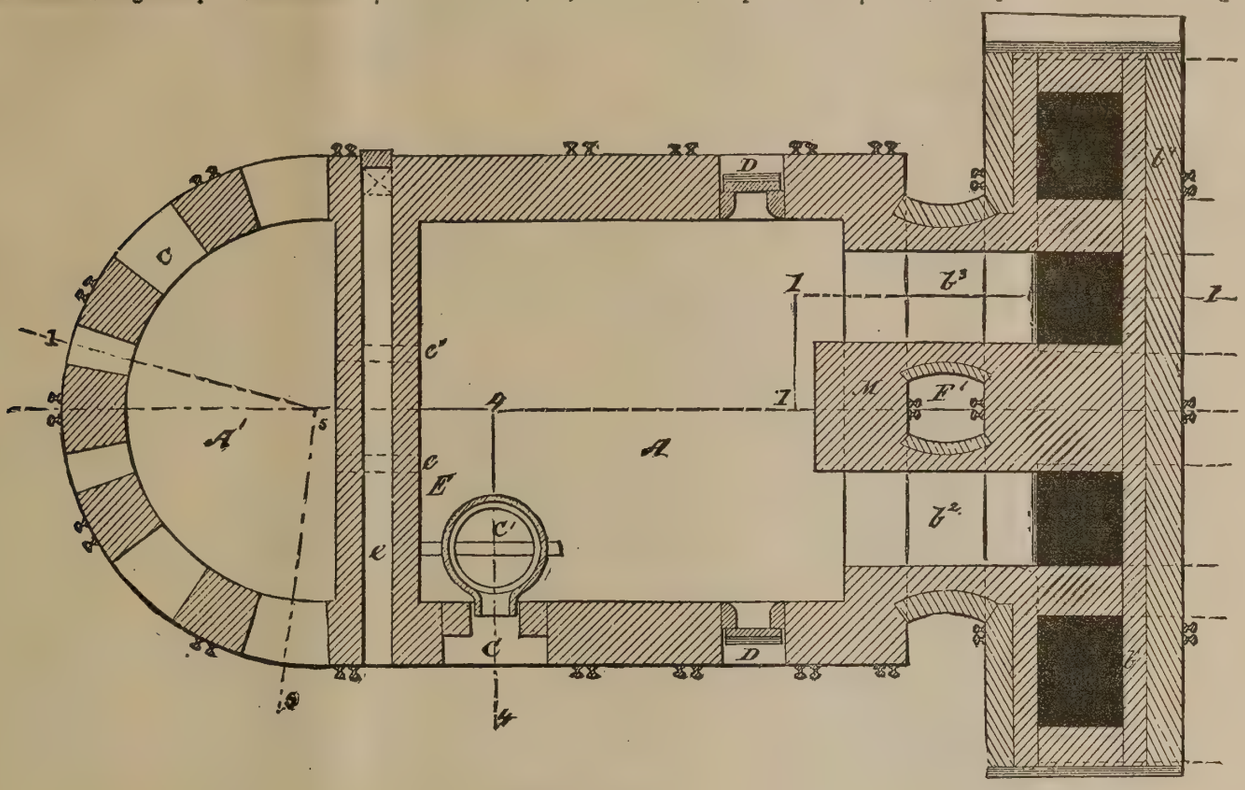


Fig. 4.—Sectional Plan.

The upper portions of this brick-work take up the first, and, therefore, the highest degree of heat, and as the burnt gases are passed downward through the regenerators, they are by degrees very completely deprived of their heat, and reach the bottom of the chambers and chimney comparatively cold. After this action has been going on, say for an hour, the reversing valves are turned over. They are simple flaps, acting like a four-way cock, and by throwing over the levers which work them, the direction of the currents is reversed. The gas and air will enter now through the second pair of chambers, and the air passing up through one generator and the gas passing up the other, will take up heat from the bricks previously heated by the descending current. The gases as heated, say to 1,000° Fah., will enter into combustion, and if the heat produced at the former operation were 1,000°, it ought this time to be 2,000°, because the initial point of temperature is 1,000° higher. The products of combustion will also escape at 2,000°, and passing through the checker-work of the first pair of regenerators, its uppermost ranges will be heated to very nearly 2,000°. The temperature will diminish by degrees in descending, till the gaseous currents have again reached the bottom nearly cold. Again reversing the process, after another hour or half hour, as the case may be, the gas will take up heat to the extent of nearly 2,000°, and since another 1,000° is again produced in combustion, the temperature of the furnace will this time attain 3,000°, and in this way it might be argued that, unless work is done in the furnace, the heat developed in combustion will, step by step, increase the temperature of the furnace 1,000°, or something less, each time a reversal of the valves takes place, till we arrive at the practical limit imposed by the melting point of the most refractory substance we can find (pure silica, in the form of Dinas brick), of which the melting-chamber of steel-melting and the arch of glass-melting furnaces are usually formed.

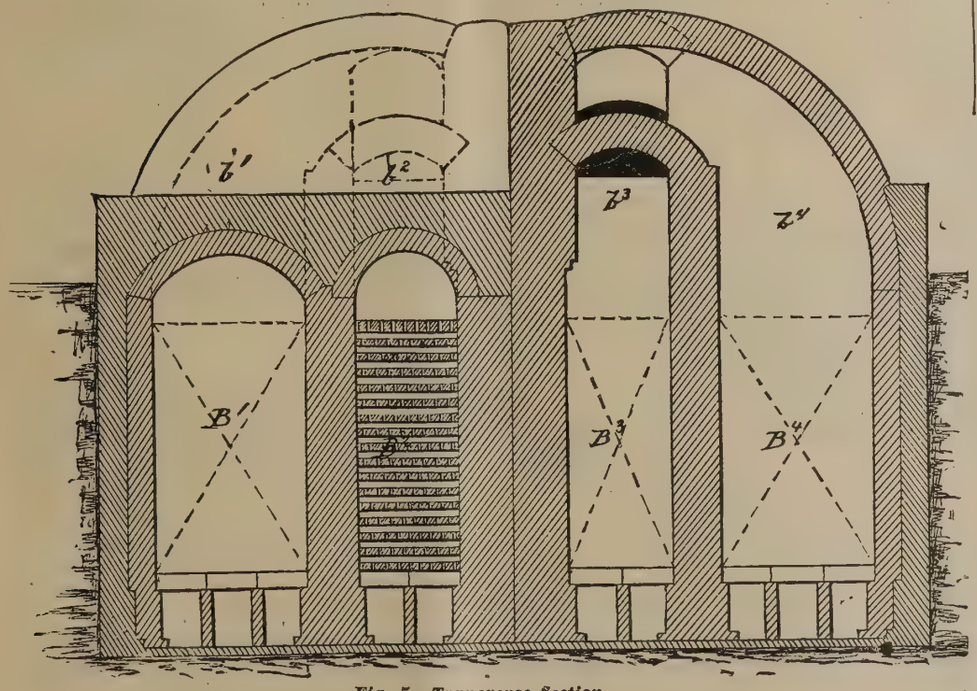


Fig. 5.—Transverse Section.

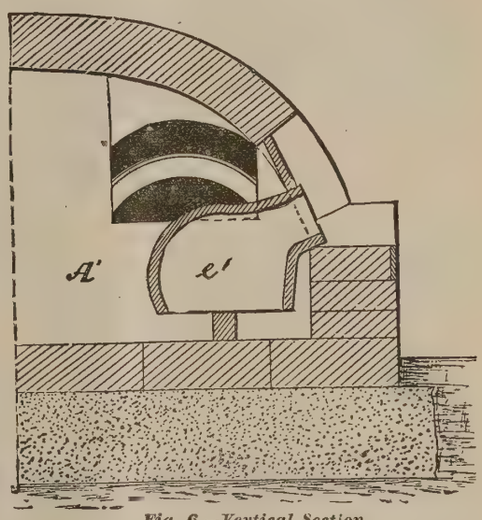


Fig. 6.—Vertical Section.

The economical action of the furnace is apparent from the fact that nearly all the heat produced in actual combustion is available for accomplishing useful work, the combustion products reaching the chimney at a temperature not exceeding 300° or 400° Fah. And the economy resulting from its use, therefore, will be most decided in operations, such as glass-melting, requiring very high temperatures. That this is the case, is proved by the fact that in melting steel in bulk upon the open hearth of a Siemens furnace, the consumption of fuel is reduced to 12 cwt. per ton of metal; and in melting glass there are continuous furnaces in operation, requiring less than 15 cwt. of coal to the ton of glass made, as compared with from 2 to 3 tons in the old cone and pots. For glass-melting

on a large scale, as now practiced, a cluster of producers are put up outside the works, and the fuel is delivered by railway at an elevated point, from which it is fed to the producers, and is delivered in the gaseous state to the furnaces.

The refining vessels are of pot-clay, and vary somewhat in size and form, according to the character and the quantity of glass intended to be produced. The gathering compartment is sometimes made entirely open, sometimes covered wholly or partially with a hood, but in all cases the vessels float on the metal in the tank, and are constructed so as to be easily removed when worn out. By the employment of these refining vessels, dividing bridges in the tanks are no longer required, and thus that part of the structure which, in the best forms of continuous glass-melting furnaces, was subject to the most wear, is suppressed. Another advantage is found in the circumstance that the ends of the blowing canes, which sometimes break off in the glass, may be easily picked out from the bottom of a refining vessel, instead of it being necessary to empty a tank from time to time in order to remove, as useless, the glass discolored by such accidental introduction of iron therein.

The color of the glass made in a tank may be altered from time to time, as required, without interrupting the blowers; and for this purpose, it is only necessary to cease charging a batch into the furnace for a few hours, when some of the new glass mixture is introduced, and further charges made at regular intervals; according to the productive capacity of a tank, the change of color will be effected in from three to five days, and only a few hundredweights of mixed metal are formed, which have to be ladled out.

For works requiring the regular production of glass of different colors or character in insufficient quantities of each sort to warrant the erection of a special furnace for each variety, the tank may be divided into two or more compartments, or several large pots may be set in a furnace, each of which shall have the desired number of refining vessels. By surrounding these pots with sand, they will be much strengthened, so that they may be made larger than usual, and thus form several small tanks in one furnace, which can easily be removed when required. In this manner the continuous melting glass process may be applied to both large and small productions, and will, therefore, be of interest to all glass manufacturers.

The principal advantages claimed to result from the use of the continuous-melting furnace, are: 1. Increased power of production, as the full melting heat may be employed without interruption, while with the old method of melting, nearly one-half of the time is lost by cooling and settling the metal, the working out of the glass, and the re-heating of the furnace. 2. Economy in working, as but one-half the number of men are required for the melting operations. 3. Durability of the furnaces, owing to the uniform temperature to which they are subjected. 4. Regularity of working, and improved quality of the glass made. 5. Convenience to the men and advantage to the masters, as, owing to the continuous action, the metal is always ready for the blowers, and the gatherers have to draw the metal from a practically constant level. 6. For the manufacture of window glass, the working out end of the furnace may be so arranged that the blowers can work without interfering with the gatherers. This would do away with the separate blowing furnace now in use.

Dr. Siemens has of late made considerable improvements in his system of continuous-melting furnaces, and the engravings given on the two preceding pages represent some of these later forms. Fig. 1 is a longitudinal vertical section of the continuous glass-melting furnace, and Fig. 2 a partial transverse vertical section of the same. A is the melting compartment, separated from the working-out compartment A^1 by the bridge E, which is formed with an air-flue *e* for cooling, and with passages *e'* for the molten metal. A pair of regenerators B′ B″ are placed at each side of the furnace, communicating with it by the flues b^1 b^2, between which cooling air-flues *h* are formed in the side walls, these flues rising from a cold-air chamber or cave H, formed beneath the tank; D is the feeding-door, and C the working-out holes. The usual mode of charging furnaces of this description, by shoveling in the materials or batch, gives rise to the formation of a considerable amount of dust, which attacks the sides and roof of the furnace, and is partially deposited in the regenerators, causing them to clog up. This evil is remedied by the use of a scoop of peculiar construction.

Another late improvement has for its objects, first, to effect the uniform cooling of the exterior surface of the tank of a continuous-melting furnace; and, second, to render the sides of the tank available for working-out holes and charging-doors. These objects are attained by placing the regenerators on one side of the melting-chambers, causing the combustible gases to enter and the products of combustion to leave the melting-chamber from the same side thereof. The remaining sides are then available for working-out holes, which may be arranged in the manner most suitable for the work to be done.

In the accompanying plate of drawings, in which corresponding parts are designated by similar letters, Fig. 3 is a longitudinal vertical section of the continuous glass-melting furnace, taken on the line 1 1 of Fig. 4, while Fig. 4 is a sectional plan taken on the line 2 2 of Fig. 3. Fig. 5 shows on the right-hand side a transverse section on the line 3 3, Fig. 3, and on the left-hand a transverse section on the line 3^a 3^a of Fig. 3. Fig. 6 is a vertical section taken on the line 4 4 of Fig. 4. A is the melting-chamber, at one side or end of which are placed the four regenerators B^1 B^2 B^3 B^4, of which the one pair of air and gas regenerators B^1 B^2 communicating with the melting-chamber A through the passages b^2 b^3, situated one above the other, while the other pair, B^3 and B^4, communicate with the chamber A through the corresponding passages b^3 b^4. Thus the gas and air passing into the chamber A through the one set of passages b^1 b^2, and being ignited, sweep round the melting-chamber and escape through the passages b^3 b^4 to the other pair of regenerators. E is the fixed bridge, with a passage *e* formed right through it to a flue at one side, acting as a chimney for the circulation of the air, and with apertures *e'* *e'* at the bottom, through which the finer metal passes from the melting-chamber A into the compartment A^1, whence it is worked out through the opening C. A passage F is formed beneath the throats of the regenerators, communicating with a vertical passage F^1 between the throats, for keeping the brick-work cool by the circulation of air.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

NEW YORK CITY BUILDING ITEMS.

The property on the corner of Broadway and Ninth street, has been leased to G. B. Bunnell, and will be at once altered into a museum. There will be several large halls for the exhibition of living curiosities. There will also be a theater in miniature.

John I. Dawson & Bro., of Gray's Ferry Iron Foundry and Machine Works, Philadelphia, are about to erect buildings that will cover about two acres of ground, on Gray's Ferry Road, between Twenty-ninth and Thirtieth streets. The principal building is a foundry, one story high, 75 by 200 feet, in addition to which will be a machine-shop 50 by 100 feet, and a boiler-shop, 40 by 60 feet, to be completed by January 1, 1881.

Three architects are now preparing plans for the Produce Exchange Building which will be submitted about Christmas, and will be exhibited to members of the Exchange for at least fifteen business days. Afterward a ballot will be taken, and the plan receiving the majority of votes will be adopted. The site has been purchased and the building now standing on it will be removed about May 1, 1881. The site extends in Whitehall street and Broadway from Stone to Beaver streets, with a depth of about 170 feet in Stone and Beaver streets. The building will cover about 50,000 square feet. It will be built in about the same style as the Boreel Building on Broadway, and the estimated cost is about $600,000. The frontage will be 307 feet. A part of Marketfield street will be closed, and a new street will be cut from Beaver street to the part of Marketfield street left open back of the Exchange. An open yard, covering between 6,000 and 8,000 square feet, will run back of the building from Marketfield street to Stone street. There will probably be three floors in the exchange, beside the basement, which will be used as a reading room and for other purposes. The second floor will be used exclusively for several trades of the Produce Exchange, and the upper floor for committee and other meeting rooms. It is expected that the building will be ready for occupation before the close of 1881.

J. Lester Wallack has leased the property at Broadway and Thirtieth street, extending from the Grand Hotel on Broadway to the corner of Thirtieth street, and around in that street to and including the first two private houses, making a frontage on each thoroughfare of 150 feet. All the buildings within these boundaries are to be razed at once and a new and elegant theater erected in time to be thrown open at the commencement of the next season. The lease is for sixty-six years. The negotiations were made with John Kirkland and W. Scrymser. The new building will be supplied with all the appointments of a first class modern theater, and Mr. Wallack declares his intention to make it the most complete and elegant place of amusement in America. The seats will be arranged on the plan which Mr. Wallack has decided upon after years of observation. The auditorium will hold as many spectators as the present theater at Broadway and Thirteenth street, but the seats will be more commodious There will be an entrance in Broadway, and one in Thirtieth street. Mr. Wallack will adopt the most improved plans obtainable for safe exit in the event of fire or accident, and the heating and ventilating appointments will be as nearly perfect as possible. The old theater now in use will either be leased to other parties or operated on a different basis. Mr. Wallack finds that it is too far down town to suit the convenience of his patrons, who have urged him to go further up.

MISCELLANEOUS.

A new building is proposed for the Department of Agriculture, at Washington.

The Chicago Sugar Refining Company are erecting extensive works on West Taylor street, Chicago. The cost is estimated at $200,000.

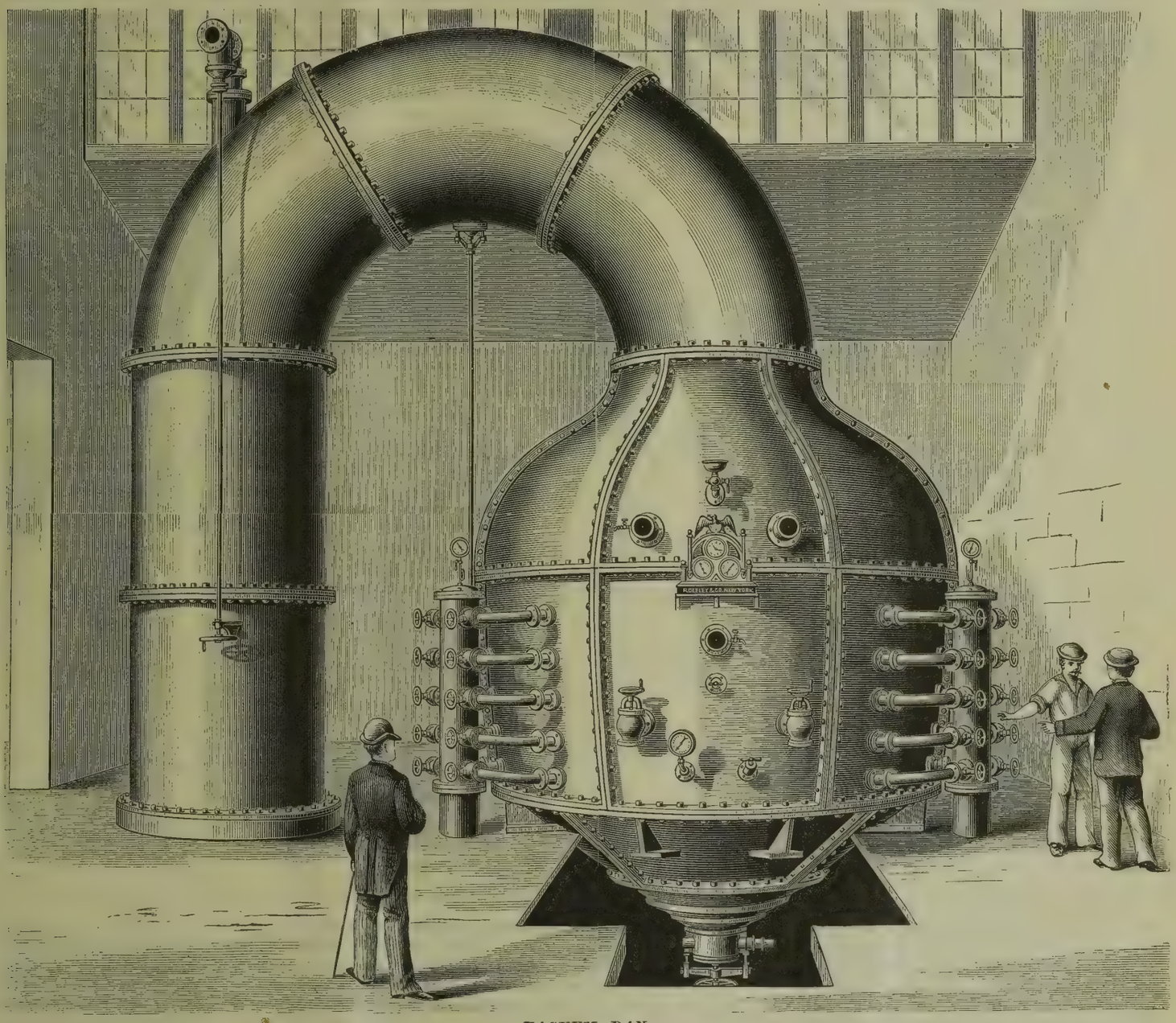
Active preparations are being made for the rebuilding of the works of the Ansonia Clock Company, in South Brooklyn, which were destroyed by fire several weeks ago. The new buildings will be erected on the site of the former works, which is included between Seventh and Eighth Aves., and extends from Twelfth to Thirteenth streets. It is proposed to erect the main building on the foundation occupied by the old one, but it will be three instead of five stories in hight. It will have a frontage of 220 feet, and an equal depth. Back of this will be smaller buildings for brass and iron foundries, wood drying, and boiler houses and stables. The capacity of the works will be about one-third greater than before, and considerable improved machinery will be introduced. Drawings of all the special machinery used in making fine work were saved from the fire, and the company has thus been enabled to reproduce them. It is also proposed to erect a separate building, 200 feet long and 40 feet wide on adjoining lots for the manufacture of an especially fine class of work. The manufacture of the clocks previously made will be continued, and others will be added. The material for the new buildings has been secured, and it is expected to have the main building ready for use by January 1.

A Large Vacuum Pan.

We show in the annexed engraving an external view of one of the largest vacuum pans ever constructed. This apparatus, which was made by Messrs. Robert Deeley & Co., of New York, for Mr. C. Spreckles, of the California Sugar Refinery, San Francisco, Cal., is interesting, not simply because of its size, but likewise on account of its very superior construction. The following is a brief description:

The shell is of cast iron, and is 12 feet in diameter. It is made in three sections, comprising respectively the top, belt and bottom, and for convenience of transportation, the top and belt in turn are each made in six sections. These sections are carefully flanged and fitted, so that when bolted together they form perfectly tight joints. The capacity of the pan is about 7,600 gallons, which will yield at each operation from 250 to 260 barrels of dry sugar. The lengths of the inclosed five copper heating coils are, respectively, 189, 194, 203, 206 and 208 feet, and have a combined heating surface of about 1,000 square feet. Each coil is divided into four sections of about 50 feet each, and each section has an inlet and outlet, an arrangement which insures superior economy of heating surface. The inlets are connected by brass valves to 10-inch trunks, one on each side of the pan, and the outlets, 20 in number, are connected with steam traps, which carry off the water of condensation. From the top of the huge vessel proceeds the curved over-flow pipe, having a diameter of 5 feet; and connecting with this, and reaching down through the floor, is the condenser, having the same diameter, and a hight of 18 feet. The condenser is furnished internally with a number of plates for distributing the water, to more effectively condense the steam and vapor discharged from the vacuum pan. The steam trunks, which supply the heating coils, are each provided with a steam gauge and a supply valve, which is connected with a receiver that takes exhaust steam from the engines and pumps used in the refinery. The pan is provided with a 4-inch valve for admitting the air in breaking the vacuum. It is furnished with two 4-inch charging valves, which admit the charge through two copper pipes reaching well down to the bottom of the pan. Two thermometers are also provided for determining the temperature of the liquid in the pan, one of these being located near the top, and showing the temperature of the upper layers of liquid, and the other near the bottom, to show the temperature at the lower level of the liquor. Several tubes, with nicely fitting valves and a piston, answer the purpose of proof-sticks, and permit of the removal of some of the syrup from time to time without disturbing the vacuum, for the purpose of testing the degree of its concentration.

The above description, in connection with the excellent illustration with which we accompany it, will give our readers a general idea of this monster apparatus and its attachments, but will do very inadequate justice to its admirable completeness and the very superior workmanship, both in design and execution, displayed in its construction, which reflect the highest credit upon the makers. The manufacturers in question having an immense establishment and unsurpassed facilities for turning out work, have achieved an enviable reputation both for the extent and variety of their productions and for the superiority of the latter in point of design and excellence of workmanship. Of the machinery built by this firm, we may incidentally mention cane-mills, defecators, filtering and purifying apparatus, condensers, evaporators, vacuum pans and triple effects, boilers, engines, pumps, centrifugal machines, and, in brief, all kinds of machinery and apparatus required and used on sugar plantations and in sugar refineries.



VACUUM PAN.

Any information respecting this class of machinery will be given on application to the manufacturers, Messrs. Robert Deeley & Co., foot of West 32d street, New York.

Large Marble Blocks.—Marble is on exhibition at Eureka, Cal., which came from an extensive quarry not 20 miles from the Central Pacific Railroad, and can be sawed out in blocks 100 feet long.

The Franklin Institute Experiments on the Explosion of Steam Boilers.

In the year 1835, the Franklin Institute of Pennsylvania, at the request of the Secretary of the Treasury of the United States, undertook a systematic experimental investigation of the various causes of steam boiler explosions. The committee to whom the conduct of these experiments was entrusted, performed their work with an intelligence and thoroughness that were highly creditable to themselves and to the institution; and their report, even after the lapse of nearly half a century, is still looked upon as authoritative. This statement needs no stronger confirmation than is afforded by the fact that the Hartford Steam Boiler Inspection and Insurance Company are about reviewing these experiments, with the view of testing the value of the conclusions drawn from them in the light of their (the company's) extensive experience.

is produced in the fluid." This is what the report says: "Experiments were made, which showed that on making an opening, even when the pressure did not exceed two atmospheres, a local foaming commenced at the point of escape, followed soon by a general foaming throughout the boiler, the more violent in proportion as the opening was increased. This small boiler was completely filled with foam by opening the safety valve (nearly two-10ths of an inch in area), which was placed in the middle of the top, and the water violently discharged through the opening of the valve." (This valve bears nearly the same relation to the surface area of the water in this little boiler, when half full, that a 2½-inch valve would to the water-surface in a plain cylinder boiler 30 inches diameter by 30 feet long, when half full, or a 2⅝-inch on a 36-inch by 30-foot boiler).

"The boiler was half full of water in these experiments. *The gauge fell always on making the opening.*" The committee, commenting on this experiment, say: "It is interesting in two points of view; first, in its effect upon the apparatus designed to show the level of the water within the boiler; second, by its throwing the water against the heated sides of the boiler."

through which it is impelled. By its force safety valves and their housings have been blown off bodily from steam boilers, by the too sudden opening of a safety valve of large area, and by its force initial ruptures in explosions are developed into a complete destruction of the boiler shell. The discussion of the effect of "throwing the water against the heated surfaces," is reserved for its proper place after the experiments which the committee made with the sides of the boiler heated red hot. These experiments are very interesting and important as bearing on the subject of explosive evaporization of water. The gauge cocks in the experimental boiler, *a, b, c*, Figs. 1 and 2, were 1.95 inches and 1.8 inches apart, measuring from the center of the open of the middle one above and to the one below.

"The steam in the boiler being not higher than two atmospheres, the following experiment was made: The level of the water was reduced until it stood just below

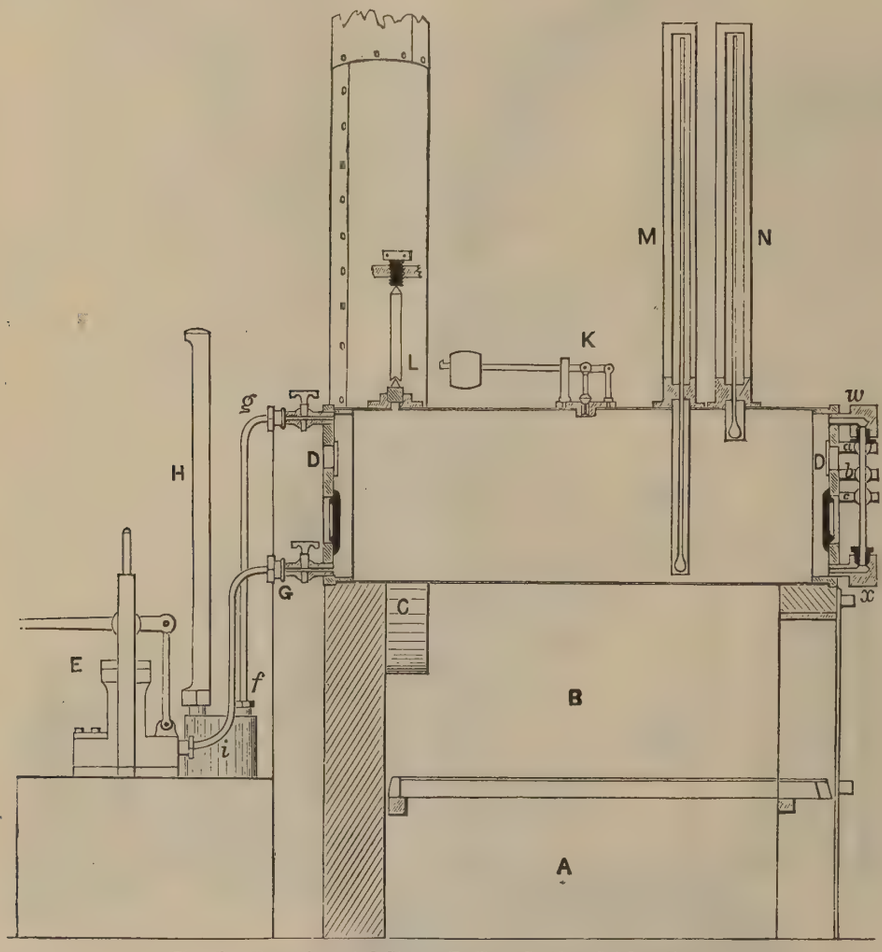


Fig. 1.—Experimental Steam Boiler—Sectional Elevation.

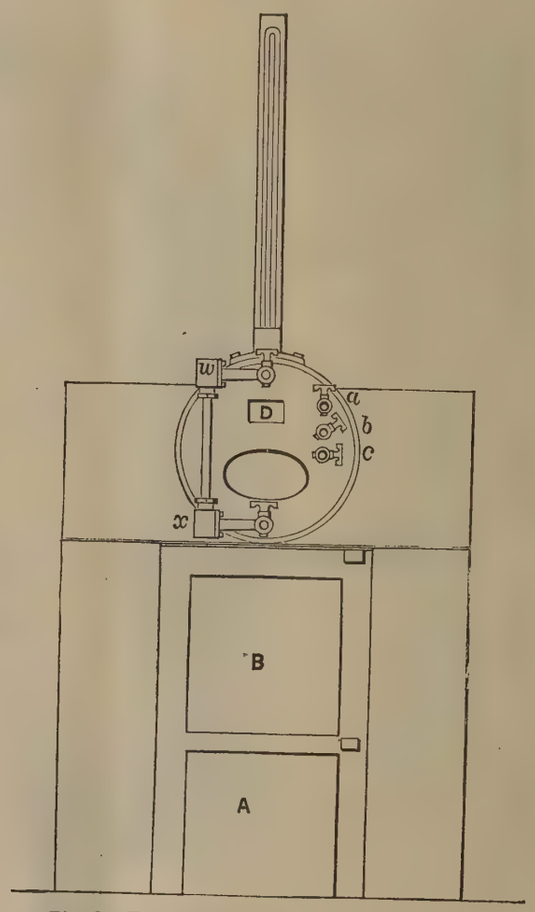


Fig. 2.—Experimental Steam Boiler—Front End.

The last number of the monthly bulletin of the company contains a first installment of this promised series of articles, which our readers will find to be of special value and interest. By kind permission of the company we are enabled to present this interesting contribution to an important subject, with illustrations of the apparatus devised and used by the committee.

Fig. 1 is a sectional elevation of one of the experimental boilers, which was a plain cylinder 12 inches diameter by 34 inches long, with cast-metal heads, set in brick; and Figs. 2 and 3 are respectively front and rear end views of the same boiler. Fig. 4. is the metal sash which was put over the glass windows at later experiments, to make them more secure. It was fitted with a closed mercury gauge, gauge cocks, safety valve, water glass, and several thermometers. It had also glass windows D in the heads, 2½ × 1¾ inches, one in each head, through which to observe the interior. Reference letters refer to the same parts in all the cuts.

The first experiment with this apparatus, was "to ascertain whether, on relieving water heated to, or above the boiling point, from pressure, any commotion

The fact which is printed in italics above, is recommended for study to those who have a superstitious notion that a rise of pressure follows the act of opening the safety valve. The danger, it seems, comes solely from the sudden formation of a heavy foam, which rushes violently towards the point of least pressure. The word "foaming," used in this connection, should not be confounded with "frothing." The froth upon the surface of foaming liquors and heated water filled with steam bubbles are quite different bodies. Froth is mostly air or gas bubbles with the thinnest of liquid envelopes, while foaming water in a steam boiler may be almost "solid water, made white and projected by the contained steam bubbles, and its momentum during expansion is a force not to be despised when concentrated upon the surface surrounding the opening

the lowest gauge cock. On opening this cock, steam at first flowed out, then water and steam; on opening the second cock, in addition, water flowed freely from the lowest, which was above the hydrostatic level; The foaming within the boiler, which was produced by thus relieving the pressure, was distinctly seen through the glass windows. On opening the third cock, steam and water issued from the second, which was 2 inches above the water level; and on partially raising the safety valve, water flowed freely from the second cock. A further rise of the valve filled the boiler with foam, water flowed freely out of the third cock, more than 3¾ inches above the water level, and finally through the opening of the safety valve itself." In these experiments an opening of .03 of a square inch in area, the lowest cock, which to the area of the water surface was as 1 to 13,700, caused the water and steam to issue through the cock below which the water was known to be. A further opening .03 of a square inch, making with the first, .06 inch, or one-6850th of the area of the water surface, brought water from the lowest cock; a total of .09 of an inch (one-4567th of the area of

the water surface) brought water and steam from the middle cock, indicating that the level of the water was nearly 2 inches higher than it really was. "A first apparatus which was contrived for applying fusible plates to the boiler, suddenly opened an aperture of .95 of an inch in diameter." (See L, Fig. 1). Even at low pressures, the scalding contents of the boiler were violently discharged, through this opening, against the roof of the experiment house. "It is now time to speak of the glass gauge tube as a means of indicating the level of water within a boiler, in connection with which an experiment bearing upon the performance of the gauge cocks will be stated."

After some trials of a prismatic glass water-gauge, which proved too frail, the committee's report describes the glass water-tube gauge shown in section, Fig. 1, and in elevation, Fig. 2, *w*, *x*, which will be recognized as substantially what is in use to-day for indicating the water level. They say: "The gauge used was 9¾ inches in length, the upper part being so near the top of the boiler as only to be affected by the foaming in extreme cases, and the lower part so near the bottom that the level of the water was indicated, unless when very low indeed."

The committee experimented in this connection with some apparatus devised by Mr. Thomas Ewbank, for ascertaining the water level by means of internal perforated attachments to the gauge pipes. Alarm floats were tested by the committee, and a full description given of one used by Mr. Ewbank, which was to be wholly enclosed in the boiler to avoid the stuffing-box commonly used to pass the index-rod of the float through the top of the boiler. The committee say on this subject: "A float serving to give an alarm by the issuing of steam was made the subject of a few experiments, and answered well, as far as those trials went. Long use, however, could alone determine perfectly the peculiar liabilities to derangement in this apparatus". The point next examined by the committee, was the effect of foaming on the elasticity of steam within the boiler. The proposition was as follows: "When an opening is made in a boiler, of which the sides are heated, will the effect be to diminish the elasticity of the steam within, by permitting its escape? or will the water thrown upon the heated sides by the foaming which results, be converted so rapidly into steam as actually to increase the elasticity of the vapor within?" The report continues: "It is obviously difficult to obtain an answer to a query involving so many conditions. It might be expected, however, that a small boiler would afford satisfactory means of making a fair trial of the question, since the size of the openings could be varied very easily, so as to make them comparatively small or very great. The position of the boiler used by the committee in its furnace was such that the sides could be readily heated, thus placing it in favorable circumstances to increase the elasticity of the steam by producing a foaming within. The apparatus was, therefore, adapted to make the desired trial."

Just here, following, appears a sentence in the report which gives, in a word, the origin of the superstition that the pressure increases on making an opening: "M. Arago, in his essay on the explosions of steam boilers, states that MM. Tabareau and Rey, at Lyons, found, on opening a large stop-cock connected with a small high-pressure boiler, that the safety valve rose, showing an increase of pressure within. . . . The experiments of MM. Arago and Dulong, at Paris, were attended by a contrary result, the opening of the safety valve being always accompanied by a diminution of pressure. . . . The circumstances, however, were not the same as those in the experiments of MM. Tabareau and Rey." To repeat this experiment, a hot fire was made beneath the boiler, and when the water had fallen to about 3 inches above the lowest line of the cylinder the experiment was commenced, the pressure being about 3 atmospheres. A stop-cock .03 of a square inch in area, one-10,960th of the area of the water surface at the beginning of the experiment, delivering per second, at 3½ atmospheres, about 409 cubic inches of steam, was first opened; next the safety valve was raised, either in part or entirely, the area of which, when entirely raised, was .208 of a square inch, or one-1050th of the water surface, and capable of delivering in one second, at 3½ atmospheres, a bulk of steam nearly 9 times that of the steam chamber. The water level falling by the waste caused by the experiment, the steam soon became surcharged with heat, and the iron of the boiler, from near the water-line to more than one-third of the distance from the lowest line to the middle of the convex surface, became on each side of the water-line heated until it attained redness, passing of course through the temperature of maximum vaporization of the water thrown by the foaming upon the iron. The experiments were made at intervals, until all the water was exhausted. Water was then injected in small quantities, and, with the bottom of the boiler for the most part red-hot, the trials were repeated.

Fig. 4.

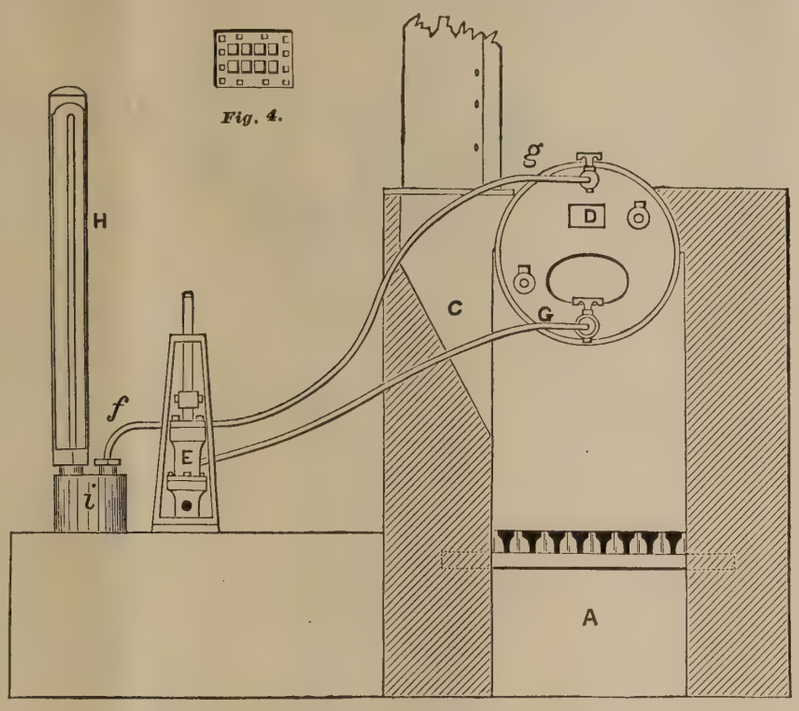


Fig. 3.—Experimental Steam Boiler—Rear End.

It will be seen by the accompanying table that the result was uniformly a diminished elasticity of the steam within, as shown by the fall of the mercury in the steam gauge. The pressure varied, in the former part of the experiments, from 3½ to 8 atmospheres. The first column in the table contains remarks referring to the level of the water in the boiler; the second, the openings made; the third is the temperature by the thermometer, which reaches nearly to the bottom of the boiler; the fourth is the hight of the mercury gauge before making the opening; the fifth, the hight immediately after making the opening, unless the contrary is stated in the sixth column, which contains remarks relating to the effect on the gauge; the seventh column contains general remarks.

Remarks on the Depth of Water.	Nature of opening.	Temp. by long Ther. M. Fahr.	Hight of Steam Gauge. Before. Inches.	Hight of Steam Gauge. After. Inches.	Remarks on the Depression of the Steam Gauge.	General Remarks.
3 inches.....	Gauge cock..	284½	18.6	18.0	.....	Temp. of air in gauge 80°. Pressure corresponding to 18.6 inches, 3½ atmospheres.
	do.	....	20.4	20.2	.....	
	Safety valve.	....	20.5	20.0	Fall very rapid.	
	Gauge cock..	....	21.0	20.9	Fall immediate.	
	Safety valve.	....	21.3	21.0	.....	Pressure corresponding to 21.3 inches, 5½ atmospheres.
.9 of an inch.....	Gauge cock..	317½	21.9	21.8		
	Safety valve.	....	22.1	21.7	Fall in ½ second.	From about 8½ to 5 atmospheres; steam surcharged bottom, rapidly increasing in heat.
	do.	....	22.6	20.6	Fall in 2 seconds.	
.9 of an inch nearly.	Stop cock...	380	....	....	Falls.	
	Safety valve.	468½	15.1	12.6		
	Gauge cock..	....	18.0	14.0		
	Safety valve.	....	16.0	14.0	Sudden descent.	Water exhausted; supply thrown in. Ther. rose to 600°.

Thus it seems that there is no foundation for the belief that there is a rise of pressure in consequence of making an opening in a steam boiler, even though there may be hot plates upon which the water is thrown by reason of the sudden liberation from pressure upon its surface. If the opening is large enough to induce foaming, it is at the same time large enough to allow of the escape of the steam that is generated by the contact of water with the hot plates. The next set of experiments are of still greater interest to all who have anything to do with boilers. They show the effect of, and the phenomena attending, the injection of cold water into this experimental boiler.

We hope to be able to present a review and discussion of this portion of the subject in our next and succeeding numbers.

Water-Proofing Cloth.—Cloth coated with linseed oil to which a little wax and litharge have been added, will be water-proof.

How Wood Shrinks.

As it is the first essential for the making of a good workman that he shall be thoroughly acquainted with the nature and properties of the materials with which he works, so it is indispensable that the worker in wood, whether he be wheelright, cabinet-maker or carpenter, in addition to being able to distinguish and recognize the various kinds of woods and their respective qualities and conditions, should be familiar with the whole subject of the seasoning and shrinking of timber. We append a brief article on the latter topic which may convey some useful hints.

Fig. 1 shows a cross section of a tree which represents the structure and appearance of the timber commonly used with us. These trees all belong to the class known as exogens, or outward growers, since the stem grows by the addition or successive deposition of layers of wood on the outside, beneath the bark. The wood, therefore, appears to be made up of a number of concentric rings, each ring representing one of the layers above named, and each representing generally one season's growth. The inner layers gradually become filled and hardened, and form what is known as the "heart-wood," while the outer layers are softer, and form what is known as the "sap-wood."

The accompanying cuts, for the use of which we are indebted to the *Blacksmith and Wheelright*, will serve to illustrate the subject. Fig. 1 represents a cross section through the trunk of a tree such as we have been describing. The center is occupied by a circle *p*, representing a column of pith. About this will be noticed the concentric rings *a a* of annual growth, and surrounding the whole, the bark *b b*.

Fig. 2 is a vertical section of a tree showing the movement of the sap. The arrows directed upwards indicate the course of the fluid in the spring and summer, and the downward arrows represent its descent in the latter part of summer and early fall, through the cells situated between the last annual ring and the bark, where a new layer of wood tissue is formed.

In Fig. 1 are seen a number of thin lines *m m*, radiating from the pith, or medulla. These are known as medullary rays. In certain woods, such as some kinds of oak, they present a finely figured appearance, sometimes called silver-grain. These rays serve a useful purpose in the nutriment of the tree, and in the process of shrinking the wood has a tendency to split along these rays. This is shown in somewhat exaggerated form in Fig. 3.

Lengthwise shrinking in wood is very slight, but that transversely is much greater. Our constructive woods, such as oak, etc., are built up of fibrous tubes, ranged, as above remarked, in concentric circular

Fig. 1.

layers, bound together by radial plates or rays, which are the silver grain of the carpenter and the medullary rays of the botanist. The effects of seasoning depend on these radial plates, because the fibers cannot shrink laterally without tearing them apart, and hence the timber splits lengthwise in radial plates, and the log retains its full diameter. If the whole mass of tubular fiber were to contract bodily, the plates would be crushed and the wood ruined. Fig. 4 represents the appearance of a log cut in quarters before shrinkage has commenced. The straight sides of each quarter are equal, and at right angles, or "square" with each other.

Fig. 5 illustrates the same log after seasoning, showing the effect of seasoning on one of the quarters. The sides of the log are no longer "square," but are diminished by the portion shown in black.

Fig. 2.

Fig. 6 represents the appearance of a log sawed into five planks, showing that the effect of seasoning on each plank is different. The central plank retains its original thickness in the middle, because the rays resist the thrust, and gets thinner at the edges because there the rays are parallel with the thrust, and hence do not oppose the shrinkage. The breadth of this plank is not lessened, because the shrinkage in that direction is opposed by the rays as braces. The planks at each side of the center retain their original thickness in the middle, become a little narrower, especially on the outside face, and hence bend from the heart side. The next two are no thinner in the center, and not much thinner at the edges, but are greatly convex on the heart side, and strongly concave on the outer face. If one of these planks were cut into squares when green, the shape of each of these would depend on what part of the tree it came from. Fig. 7 represents such a square cut from near the outside of a log, the figure A C B D being the original shape, and the enclosed figure that after seasoning. Here the shrinkage has not taken place in the radial lines, but in a direction perpendicular to them.

The "end grain" will show from what part of a log a plank is cut. Fig. 8, for example, shows an end section of a plank cut from near the outside of a log; and Fig. 9 that of one cut from the center. We must expect the first-named to shrink in width, and the last to get thinner at the edges. In very soft wood these thin medullary plates are not so strong as to entirely resist crushing, and hence the rules here explained are not so strictly obeyed as with hard woods.

Strength of Yellow Pine.

From a paper read by Prof. R. H. Thurston before the American Association for the Advancement of Science, we find some very interesting facts relative to the strength of yellow pine and other timber. Prof. Thurston made experiments for determining the modulus of elasticity, using a very large number of specimens in his trials. He found that the deflection of timber bearing a load and supported at the extremities, is very nearly proportional to the load, even far beyond the customary limits of strain, and that the modulus is very nearly constant for all moderate deflections. When higher loads (as one-fourth or one-eighth the maximum) were imposed for a considerable time, as ten or twenty minutes, the deflection gradually increased; on removal of the weight, it steadily decreased, returning nearly to its original set. Heavy loads, long applied, produced fracture of pieces, the companions to which resisted considerably more when the load was increased steadily up to the moment of fracture. The maximum permanent load was apparently something less than one half and greater than one-third the maximum load which could be sustained under ordinary test.

From the whole series of experiments, Prof. Thurston drew the following conclusions: The elasticity of yellow pine timber, such as is generally used in construction, is very variable, the modulus ranging from 1,000,000 to 3,000,000, the average being about 2,000,000 in small sections, and a little above 1,500,000 in large timber; the highest values are given as often by green as by seasoned timber; the density of the wood does not determine the modulus, the figure varying sometimes directly and sometimes inversely, as the density, even where the amount of seasoning was alike; a high modulus usually accompanies high tenacity and great transverse strength; the resistance offered to transverse stresses is greatest where the lines of grain are vertical.

Prof. Thurston recommends the designing and constructing engineer to adopt a moderate value of the modulus in proportioning a work, and by careful inspection and test to secure the rejection of all material which is not of good quality.

To Obtain Well Defined Castings.

To obtain sharper and better defined castings, Messrs. Thorp and Tasker, of Whitefield, Lancashire, England, enclose the mold or molding-box within a chamber, in which a suitable degree of vacuum can be obtained, and they run in the metal in vacuo, and afterwards admit air or gas into the chamber. In the apparatus they have devised for the purpose, the molding-box is enclosed in a metal chamber, which is provided with a lid or door, the meeting surfaces being planed or faced, so that a suitable air-tight joint is obtained when the door is closed, with or without the interposition of a joint ring or of backing, as preferred

Fig. 3.

or found to be most efficient. A shaft to carry a crucible or pot to hold the melted metal, passes into the interior of the chamber, and is provided with handles or with arrangements for tilting the said crucible or pot. A slight hole closed with glass, or two or more of such holes, is or are formed in said door or in any suitable situation in the walls of the chamber, so that the progress of the running in may be inspected. The

said chamber is connected with a vacuum chamber, in which a degree of vacuum is obtained by means of an air pump or of air pumps, or by other suitable means. When the arrangements for the running are completed, the door of the molding chamber is closed, and the communication with the vacuum chamber is opened. The metal is then run into the mold, and air is admitted into the molding chamber. The firm prefer to use a

Fig. 4.

two-way cock, which, when turned to shut off the connection with the vacuum chamber, opens a passage for the admission of air to the molding chamber. The last named chamber may be large enough to contain more than one molding box. The chamber may be connected directly with the air pump, so as to dispense with the vacuum chamber, or the air pump employed to increase the tension of the vacuum partly formed by the said vacuum chamber. In place of the crucible or pot being enclosed within the chamber, the metal may be poured into a passage leading from the outside to the inside of the chamber, or into a container communicating with the interior of the chamber or with the interior of the mold, the atmospheric pressure forcing the metal into the chamber or mold, when a plug closing the passage is withdrawn or eased, or when the passage is otherwise opened.

The Simplon Tunnel Project.

It is probable that before these lines meet the eyes of our readers, the preliminaries for the piercing of another great tunnel through the Alps will have been effected. The French are specially anxious to counteract the effect of the diversion of traffic which the opening of the St. Gothard tunnel will entail upon their country, and of which traffic the Mont Cenis route has hitherto given them the monopoly. The tunneling of

Fig. 5.

the Simplon will, if completed, effect this object by providing a more direct route between France and Italy than the St. Gothard; and it is this project which is at the time of this writing attracting the serious attention of the French government. A brief history of the scheme is given below, from which its importance may be estimated.

If the Simplon tunnel project should be pushed forward to completion, it would make the fourth great bore under the Alps, the others, in the order of their completion, being the Mont Cenis, St. Gothard, and Arlberg tunnels, while still a fifth is contemplated under Mont Blanc. Over a year ago, the Federal government and several of the Canton governments of Switzerland had extended aid to the amount of 13,500,000 francs, and the Swiss Occidental Railroad, which will be the connecting line, had made a grant of 5,000,000 francs. The capital of the company that is to do the work is 13,500,000 francs, so that if the French government makes a grant of 50,000,000 francs, there will be a total working fund of over 80,000,000 francs, or $16,000,000, which, it is estimated, will be quite sufficient to complete the tunnel and construct the necessary buildings and connections.

The proposed Simplon tunnel will be 18½ kilometers —about 12 miles—in length, or half again as long as that under Mont Cenis, and one-fifth longer than the nearly finished tunnel at Mont St. Gothard; but an advantage it will have over these two latter routes is found in the fact that its elevation is much less than either of them, and consequently the grades will be less steep. Indeed, the highest point on this line in the route between Paris and Milan, will be found not at or near the tunnel, but on the road between Dijon and Lausanne. The entrance to the St. Gothard lies 1,152 meters above the sea level, and that to the Mont Cenis about 1,560 meters, while the Simplon's entrance will be comparatively low, with a straight road leading to it, and an incline of only 1 in 100. Owing to its low position, there will be less interruption of work by the snow, and rivers will furnish the power necessary for boring. In the winter season operations will not need to be suspended, owing to the warmth of the climate. Geologists are of opinion that the stone of the Simplon is less hard than that of either the Mont Cenis or the St. Gothard, and it is calculated that the boring can be proceeded with at the rate of from 9 to 10 meters—over 10 yards—a day, so that the tunnel

Fig. 6.

will probably be completed in six, or at most seven, years from the date of beginning it.

The French government has strongly interested itself in the proposed Simplon tunnel, through fear of the serious result that the completion of the Mont St. Gothard tunnel will have upon transportation by French railways. With the Mont Cenis tunnel the French have held a monopoly of railroad transit between Great Britain, Belgium, Western Germany and Italy, but with the opening of the Mont St. Gothard route, this exemption from competition will cease. The latter will be much more direct, and will draw over the German railroads, via Basle, not only the foreign trade which the French companies now hold, but a considerable amount of French patronage from the Eastern provinces of the Republic. To prevent this unfortunate transfer, the government of the latter country is willing to go to considerable expense, and the route by the Simplon tunnel, which will be the most direct of the three, and which will shorten the distance between Paris and Milan by more than 100 miles, promises to bring about this desired result.

President Grevy, M. Gambetta and M. Leon Say, the most eminent of French financiers, have long taken an active interest in this gigantic undertaking, and it is altogether probable that the Assembly will promptly agree to the grant of 50,000,000 francs ($10,000,000) in aid of the project. For a few months past, how-

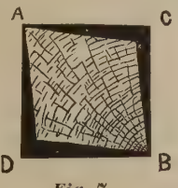


Fig. 7.

ever, a project for tunneling Mont Blanc has found much favor in France, and has been seriously considered by the government. M. de Lepinaye, Inspector of Railways, was recently commissioned to draw up a comparative report as to the various passages through the Alps that are either completed or in prospect, stating the advantages and disadvantages of each as to distance, gradients and cost of construction. The Mont Blanc route, it is claimed, has an advantage of 40 kilometers (25 miles) over the Simplon route, of 53 kilometers (nearly 33 miles) over the St. Gothard, and 72 kilometers (nearly 45 miles) over the Mont Cenis routes. From Paris to Milan the Mont Blanc route has the advantage respectively of 14, 23 and 86 kilometers over the Simplon, the St. Gothard and the Mont Cenis lines. From Paris to Genoa the corresponding advantages of the Mont Blanc route are 75, 159 and 42 kilometers over the before cited three other lines. There is the further great advantage that the extreme length

Fig. 8.

of the Mont Blanc tunnel is under 13,500 meters (about 8½ miles), which is only a little over two-thirds of the length of the proposed Simplon tunnel. But the question of expense is a vital one, and it is believed that a tunnel under Mont Blanc would demand an outlay from France of $50,000,000, or five times the amount required from that country for the Simplon project.

Improvement in Photo-Relief Printing.

The English photographic journals report that Mr. Woodbury has lately succeeded in greatly simplifying the beautiful, though delicate and expensive, process that bears his name (Woodburytype). The old process consisted in exposing a tinted gelatine film, sensitized with bichromate, beneath a negative. This gelatine surface, after suitable exposure, having become partially insoluble where the lights of the negative had passed through it, was then washed in luke-warm water, the result of which was an intaglio, or image represented by hollows more or less deep. This mold was then dried and hardened, and placed on the bottom of a shallow steel tray, the walls of which were knife-edges. A sheet of lead was placed upon the mold, and the whole submitted to powerful hydraulic pressure. The steel knife-edges cut through the lead, and the latter was forced to fill up the tray completely. The result was a reverse impression of the mold in the soft lead. This furnished the printing surface. The printing was performed by pouring melted gelatine, colored with suitable pigment, upon the lead matrix, and closing the press, by which the excess of gelatine was pressed out. The resulting gelatine print was then permanently attached to paper or cardboard.

Mr. Woodbury's modifications relate to his method

Fig. 9.

of obtaining the matrix. He proceeds as follows: He takes a positive instead of a negative, to begin with, and from this obtains his gelatine mold as before described. This is hardened as before, and attached to the surface of a perfectly smooth plate; when dry, a sheet of tinfoil is placed upon the gelatine mold, and, to force the metal completely into every crevice, the mold and tinfoil are passed through an ordinary rolling press. The gelatine mold thus protected with its metal lining, serves now the purpose of the lead matrix of the old method for printing off the Woodbury pictures.

The old method, though it was capable of producing exquisite work, required great skill and delicacy in operating. It required, likewise, such costly apparatus that its usefulness was limited. The fact that a hydraulic press capable of exerting a pressure of from 150 to 500 tons was a necessity, is sufficient to account for the fact that the process has never been generally employed by photographers. Now Mr. Woodbury dispenses at once with this expensive machinery, and places it within the power of any photographer who possesses a rolling press and a supply of tinfoil, to prepare photo-relief plates.

We are informed that the prints made on this greatly simplified plan are equal in every respect to those fur-

nished by molds in which the lead is solid; and one of the leading English journals devoted to photography, in a late *resumé* of Mr. Woodbury's work, ventures the opinion that within a year many photographers, or, at all events, those of the first-class, will take to producing their pictures by mechanical means instead of by sunlight, and exchange the frame for the press in their printing department.

Scientific.

Atmospheric Ozone.—We find in the *American Chemical Journal* a highly interesting abstract of certain arguments advanced by Schoene, a German chemist of eminence, which seem to indicate that the proofs hitherto relied on to demonstrate the occurrence of ozone in the air are fallacious. For many years the presence of ozone in the air has been regarded as satisfactorily answered; the influence exerted by ozone upon those who breathe it has been very fully discussed; and innumerable observations have been made to determine the amount of ozone in the air. In the face of all this, it is somewhat of a shock to find that a chemist of the acknowledged eminence of Schoene should at this late day seriously question the proofs which have hitherto been adduced for the purpose of demonstrating the presence of ozone in the air.

Nevertheless, Schoene feels himself warranted in making the assertion that "*as yet we possess no chemical reaction by means of which we can prove the existence of ozone in the air.*" The proofs hitherto relied on for this purpose are substantially the following reactions: 1. Something in the air sets iodine free from potassium iodide, and caustic potassa is formed. 2. Papers saturated with a solution of manganese sulphate are turned brown in consequence of the formation of manganese sesqui-oxide. 3. Thallium suboxide is oxidized to thallium oxide.

But Schoene's investigations have shown that these changes of potassium iodide and thallium sub-oxide can be as readily effected by hydrogen per-oxide as by ozone; and hence that these reactions by no means prove the presence of ozone in the air. So also the change of manganese sulphate does not require the presence of ozone, as it is brought about by air free from ozone, in which a trace of carbonate of ammonia is present; and as this last named substance is normally present in the air, the proof based on the change of the manganese sulphate papers loses its value. Other proofs that have been advanced are based on the supposed absence of hydrogen per-oxide; but as this substance has been shown to be present in the air, they are worthless.

Schoene holds that the only reagent by means of which the existence of atmospheric ozone can be positively proved is metallic silver. But neither Schoenbein nor Houzeau, nor Andrews, to whom we are chiefly indebted for investigations respecting atmospheric ozone, have ever noticed a blackening of silver in normal air free from sulphur compounds; and Schoene reports that he has been unable to detect more than the slightest change in the color of silver-foil exposed for long periods to the action of the air.

Referring to the supposed formation of ozone during thunder-storms, Schoene asserts that the odor of the air noticeable under these circumstances is not that of ozone; and he further questions the probability of the formation of ozone by lightning, since, as he urges, the electric *spark* in a mixture of oxygen and nitrogen causes the formation only of hyponitric acid, while the *silent* discharge is necessary for the formation of ozone.

It must not be inferred from the above array of objections, that Schoene denies that ozone may be present in the air. Such is not the case, his object being simply to show that at present we possess no valid proof of its presence.

Industrial Application of Cold.—The application of heat, moderate and intense, is one of the commonest aids in manufacturing chemistry and other branches of technology, but up to the present there have been few applications made of cold—that is, of temperatures below the freezing point of water. A case of this kind, which promises to give rise to an important industry, is reported in the French journals, of which we give below a brief mention.

In the neighborhood of Rheims, and in Picardy, in France, there occur extensive deposits of pyritic shales too poor in sulphur to be used in the manufacture of sulphuric acid, and which have hitherto only been occasionally utilized in the manufacture of copperas and alum. But of late the latter product has been produced so cheaply elsewhere, that, despite the cheapness of the raw material, the alum-makers of these districts have been unable to compete with others. In this state of things, M. Fournier, of Paris, undertook the task of determining if these shales could not be utilized in some other way, his special purpose being to ascertain if the sulphur they contain could not be made to effect decomposition of common salt, and thus produce the sulphate of soda, a valuable product for a variety of uses, but especially for the manufacture of soda. He succeeded in his experiments to this end, by an ingenious application of cold, as described below.

He first exposes the shales to the action of the air, by which in time the sulphur of the pyrites is oxidized to sulphuric acid, which forms, with the iron and the alumina of the clay, a mixture of iron and aluminous sulphates. They are then lixiviated with water, and the extract, which is somewhat acid, is neutralized by standing for some time in contact with iron scraps. The copperas is then allowed to crystallize out. After this, the mother liquor containing the aluminous sulphate and a small portion of iron sulphate, is run off and mixed with its chemical equivalent of common salt. The liquid is now exposed to a cold of —2° to—3° C. (=28.4° to 26.6° Fah.) A double decomposition shortly occurs, giving sodium sulphate and aluminum chloride. The sodium sulphate, however, is almost completely insoluble at the temperatures just named, and it is consequently deposited in the state of a fine crystalline sediment, while the iron and aluminous chlorides remain in solution. The mother liquor is now run off, the deposit is washed with chilled brine to free it from traces of mechanically adhering iron and alumina chlorides, dried in a centrifugal machine, and is then ready for the market. The brine used for washing is used to decompose a second portion of the chilled sulphates, by a repetition of the same operation. The sodium sulphate is used for the manufacture of soda and caustic soda.

Liquefaction of Ozone.—MM. Hautefeuille and Chappuis have reported to the French Academy the successful conclusion of their experiments upon the liquefaction of ozone. They describe a method of preparing ozone at the highest possible tension, and having this, they introduce it into a cylinder terminated by a capillary tube of Cailletet's apparatus, the same as was used in the celebrated experiments in liquifying oxygen and other hitherto non-liquefiable gases. When subjected to strong pressure, these investigators report that the color of the gas became sky-blue, and the coloration became more marked in proportion as the volume of the gas was reduced. When the tension of the gas was brought by compression to several atmospheres, it assumed an indigo-blue color. This coloration of the gas became less intense as the pressure was diminished.

By suddenly releasing the pressure after it had been brought up to 75 atmospheres, the formation of a dense white mist was observed, which is a positive indication of liquefaction or of solidification. It therefore appears to be demonstrated that ozone does not require as high a degree of compression as oxygen (300 atmospheres) in order to manifest signs of liquefaction. The observers above named pronounce it to be a little more difficult to liquefy than carbonic acid. Respecting the pronounced blue color of the gas under compression, they remark that this color is as characteristic of ozone as its odor, and that it may be recognized even under slight tension by examining a stratum of ozonized oxygen of sufficient depth. To render it apparent, they announce that by looking down a tube of one meter in length, through which a current of ozonized oxygen is passed, the color against a white surface appears sky-blue, and this color is lighter or darker as the gas is poorer or richer in ozone.

The Carrying Power of the Glaciers.—The Northern States of the United States afford the most striking illustrations to be met with in the world, of the transporting power of glaciers. All over the Eastern, Middle and Northwestern States, boulders that have emigrated from distant points to the northward, occur in such abundance that they may be found almost universally distributed. Upon Mount Kathadin, in the Moosehead region of Maine, over 4,000 feet above the sea, great masses of fossiliferous stone may be seen, which have been transported by this agency from distant Northern sites, while towards Mount Desert similar masses of distant Northern origin, 40 or 50 feet in diameter, are scattered everywhere. In Berkshire county, Mass, these traveled rocks lie in long alignments, passing over the Lenox hills and extending in a generally southeasterly direction for 15 or 20 miles, and have been filched from the Canadian and Richmond hills, as their lithological characters distinctly testify. Some granites from Vermont, on the west of the Green mountains, have been lifted over these barriers and transferred to the southern margins of Massachusetts; while in Vermont, a boulder weighing over 3,400 tons, and known as the Green Mountain Giant, has been drifted across the valley of the Deerfield River and planted 500 feet above that stream. In Michigan, near the Menomonee River, a field upon the northern slope of a mountain is densely covered with boulders, so that a distance of a mile may be traversed without ever touching the ground. Again, huge nuggets of copper, torn from the immense deposits of native copper at Keweenaw Point, Portage Lake and the Ontonagan district on the southern shore of Lake Superior, are found widely disseminated to the south of these localities in Michigan, Wisconsin, Ohio and Minnesota.

A Highly Sensitive Thermometer.—Prof. Dufour, of Paris, has devised a small thermometric apparatus, which is so sensitive that it will even denote, by a deflection of the index needle of nearly two inches, the entrance of a person in the room where it is placed. By putting the hand near the bulb, the needle is deflected the whole extent of the graduated arc. This apparatus, which we find described and illustrated in *La Nature*, consists of a bent tube, carrying at one end a bulb, which is coated externally with lampblack. The middle of the tube is filled with mercury, and is supported by an arm pivoting on a steel knife-blade. Just above the pivot is fixed an index needle which moves across a graduated arc. Beneath the pivot hangs a rod, to which is attached by friction a small weight, that serves to balance the needle so as to make it point to zero on the arc. When the temperature rises, be it ever so slightly, the heat, being absorbed by the lampblack, dilates the air in the bulb, and drives the mercury forward. The center of gravity of the apparatus being displaced, the needle will immediately turn toward the right. When, on the contrary, the temperature decreases, the needle will point toward the left. To prevent the instrument tipping over on a sudden and considerable elevation of temperature, two small pins are placed at points beneath the tube. Hooks near the bulb serve to hold substances whose diathermic powers it is desired to ascertain. The heat source is introduced into an aperture in the plate.

Malaria in New England.—The remarkable prevalence of malaria—of the genuine fever and ague kind—throughout several of the New England States during the present year, is the subject of much concern and discussion. It has prevailed with a virulence only equaled in the malarial districts of the South and West, throughout central and western Massachusetts, in all parts of Connecticut, and has extended into Rhode Island. In the city of Springfield (Mass.) and neigh-

borhood, it is said, the cases of fever and ague during a short period of the present year may be numbered by thousands. In the town of Barrington, R. I., a few miles from Providence, within an area of one and a half miles over 250 cases of fever and ague occurred during the six weeks following the middle of August. In other localities, the virulence of malaria was equally pronounced, one instance being mentioned, where, out of the 186 workmen of a factory, 185 had fever and ague with more or less severity.

The remarkable thing about this widespread outbreak, is that it is quite unaccountable. In many of the places where the outbreak was particularly severe, such a thing as fever and ague was quite unknown, and even the traditional "oldest inhabitant" could recall no instance of its previous occurrence. Nor were there any exceptional circumstances that might be credited with being the cause of the outbreak. The same lowlands that now exist over the infected districts have been there time out of mind, and there was nothing exceptional in the season. The remarkable fact remains, therefore, to be accounted for that an epidemic of fever and ague spread over an extensive district where before it had been quite unknown. We are advised that the Massachusetts State Board of Health is engaged in investigating the subject, and from the eminent scientific ability of its members, we may expect some interesting information on the subject.

Thymol as an Antiseptic.—Dr. Koller highly recommends thymol as an excellent deoderizer for the mouth, as well as a preservative for the teeth. In these respects it is preferable to salicylic acid, since the latter has been shown to have a very deleterious action on the teeth. Dr. Koller recommends the solution of thymol in glycerine as the best form of thymol for these uses. Like salicylic acid, thymol is difficult of solution in water. In alcohol it dissolves easily and abundantly; in this form, however, its intensely burning taste makes it objectionable. When taken up in glycerine, the latter masks the sharp, aromatic taste of the thymol and renders it quite agreeable for the uses above named.

Old Men as Scientists.—Recently Prof. Huxley said that ninety-nine men out of every hundred became simply obstructive after 60 years old, and were not flexible enough to yield to the advance of new ideas. The world, he thought, would be benefited by any man who had taken part in science being strangled after 60.

The Illuminating Gas of the Future.

The great improvements that have in recent years been made in the perfection of the methods and appliances for producing water gas cheaply and expeditiously, are gradually forcing the conviction upon all disinterested observers that water gas will be the base of the illuminating gas of the future. The Lowe process, and the improvements effected upon this by Strong, have wonderfully cheapened the cost of producing water gas, and the ease with which it can be charged with illuminating substances, renders the production of a permanent illuminating gas, equal, or even superior to coal gas, a matter of no difficulty. The friends and advocates of water gas processes, especially of those named above, which are undoubtedly the most perfect, have been steadily gaining ground for several years, and it can only be a question of time when water gas, charged with illuminating substances, will be very generally substituted for coal gas.

It has of late been urged against the application of water gas for illuminating purposes, that it is specially dangerous because of the high percentage of carbonic oxide that it contains; and the advocates of the old coal gas system have made the most of the objection. In reply to this, it is contended on the other hand, that coal gas likewise contains a small percentage of carbonic oxide, and that this is not the only or even the most dangerous ingredient of coal gas. The heavy hydro-carbons, especially the vaporized tarry substances, may produce, when mixed even in slight proportion with the air, vertigo, insensibility, and even death. According to Jacobs, the contents of as much as three per cent of coal gas in the air of a room is fatal to human life. Again, it is urged with considerable force, that wood gas, which has been extensively used in many European cities, contains on an average 30 per cent of carbonic oxide, and that the question of possible danger from the presence of carbonic oxide in this gas has never been raised.

The fact appears to be that the only real safety we have in using common coal gas lies in the fact that it possesses such a penetrating odor that the slightest (one-10,000th per cent) leakage can instantly be detected by the sense of smell. Coal gas, if inodorous, would be utterly unfit to use, and quite as dangerous as pure carbonic oxide. When carburetted for illuminating purposes, the odor of water gas is quite as penetrating as that of coal gas and leakages quite as readily detected. It would therefore appear to be quite as safe for household uses as the former. When used as a fuel, which is also proposed, and in some instances has been successfully accomplished, the objection above referred to becomes more apparent, since the gas does not require to be carburetted for heating effect. It will therefore be necessary for this purpose, as for illuminating, to add sufficient of the illuminating hydrocarbons to give the water gas a distinct odor.

Forests and Rainfall.

The effect of the clearing of forests in diminishing the amount of rainfall, has been very carefully studied for a series of years by Sir Gustav Wex, Chief Engineer of the improvements in the Danube River at Vienna. The fact has long been held to be established by meteorologists and others, but to the investigator above named we owe the most careful experimental proofs of its correctness. The first contribution to this important subject by this author was published in 1873, and contained a large number of observations and calculations concerning the decrease in the volume of water discharged by a number of the principal rivers of Europe. The conclusions of this publication having been questioned in some quarters, the author devoted much time to a further investigation of the subject, the results of which have just appeared in a valuable publication, entitled "A Second Treatise on the Decrease of Water in Springs, Creeks and Rivers, Contemporaneously with an Increase in Hight of Floods in Cultivated Countries," which has been translated by direction of the United States Engineer's Bureau, and in which the author states that his observations during the past six years have confirmed the correctness of his theory.

He proves by records and observations, extending over one hundred years, with respect to the rivers Danube, Upper and Lower Rhine, Elbe, Vistula, Oder, Mosel, Main, Tiber, Po, Seine, Mississippi, and others, that in nearly every case the surface level of their waters has lowered to a marked degree. He proves, also, that this lowering of the surface is due to an actual diminution in the volume of water, and not to a deepening of the river channels.

He holds that the destruction of the forests, which coincides with the advance of civilization, has been demonstrated to diminish the rainfall and to increase the tendency to floods. Sir Gustav Wex limits his inquiries simply to the influence of the clearing of forests upon the rivers; but the consequences are far more important, since they have a marked influence upon the successful pursuit of agriculture. If it is demonstrated by careful observation that the destruction of forests diminishes the annual rainfall and increases the tendency to floods, it follows as a matter of course that the rainfall (under which term we include every form of atmospheric precipitation) must be more irregular as to the times and violence of their manifestation, and must have a correspondingly unfavorable influence on the pursuit of agriculture. And this view of the case will be found to be verified by the history of every civilization the world has seen. Many quarters of the world that were once earthly Paradises, are now utterly uninhabitable by man, and given over to drought and desolation by reason of the destruction of their woodlands.

Improved Method of Making Vinegar.

The nature of the transformation of alcoholic liquids into vinegar has long been a standing question of discussion between the disciples of rival schools of chemists. Its proper explanation involves the correct interpretation of the phenomenon of fermentation. The older chemists, following the lead of the illustrious Liebig, held the view which he had advanced and advocated, that it was simply a chemical action of oxygen on alcohol. This view, however, finds to-day few defenders, the germ theory of fermentation and kindred processes having substantially taken its place. Pasteur, to whose masterly labors the world is largely indebted for the establishment and demonstration of this beautiful theory, advanced the opinion some time ago that the formation of vinegar was a physiological phenomenon, caused by vegetation of a particular bacterium, which he termed *Mycoderma aceti*. This explanation is said to have been lately demonstrated beyond a doubt to be the correct one, by experiments of Herr Wurm, made at the Breslau Institute of Plant Physiology. This observer has succeeded, according to accounts, in effecting the manufacture of vinegar on a commercial scale in accordance with Pasteur's idea. The conditions of its successful operation are stated to be the following: A sowing of pure bacteria, a uniform temperature of 30° C. (=86° Fah.,) and a well regulated addition of alcohol. The operation is carried on in large wooden receptacles, provided with lateral openings for the air, into which are placed 200 liters of a mixture of vinegar, water and alcohol, together with some mineral salts (phosphates).

The whole process is described at length in a late issue of *Dingler's Polytechnisches Journal*, to which we refer those of our readers who desire to learn further details. We will only add in conclusion that the manufacture by the new process is reported to be much more rapid than by the old, and is asserted to show a decided economy.

The Belgian Steam Cable Towing System.

This system of towing, which has lately been tested on a limited scale on a section of the Erie canal, has awakened some protests from certain owners of boats and other friends of the old towing system. These persons charged, in a formal appeal to the State Legislature, that the steam cable towing system was a failure, in that it obstructed the business of the canal, etc. The facts and figures respecting the traffic of the canal thus far during the year, do not seem to warrant this arraignment, as the following summary from the official returns received at the Produce Exchange will show, inasmuch as they demonstate that from the time of the opening of traffic on the canal to August 14th of the present year, the total traffic on the canal has been fully thirty per cent greater than for the same period of the preceding year, namely:

	1879.	*1880.*
Total tons	2,210,450	3,258,896
Total miles boats cleared	3,093,725	5,325,649
Total tolls	$343,537	$504,259

Much of this increase is not unreasonably attributed to the speed and economy of the cable service. Several hundred boats have abandoned the old towage system for the new, and it is claimed that the increased speed of the steam towing system has increased the capacity of the canal fully 15 per cent, while the boat-owners, by being able to make more trips, have enjoyed increased profits. The success of the steam towage system seems, therefore, to be assured.

A Locomotive of Novel Construction, with which the builder is reported to expect to attain a speed of 90 miles or more per hour, has been turned out by the Grant Locomotive Works at Paterson, N. J. It is intended for the Pittsburg, Fort Wayne & Chicago Railroad.

Fairbanks's Cement Tester.

Our illustration represents a neat and compact form of testing scale for testing the tensile strength of cements, made by the well-known house of Fairbanks & Co. Of late years much more importance has been attached to the careful examination of cements used for constructive purposes, than was the practice hitherto, as it became well known among engineers of construction that they differ very widely in quality; and since it is a matter of prime importance to boards of public works, and engineers in charge of important works, builders and others having to do with construction, to be sure of the quality of the materials they employ, the utility of an apparatus of this description, which is easily used and whose indications can be safely relied upon, will be manifest. It would be well if the rule were made universal, that no cements should be used in any public structure that had not first been subjected to test.

The cement tester illustrated herewith has a capacity of 200 pounds, the molds being adapted for specimens of one square inch cross section. The apparatus rests on a hard-wood base M, supported on iron legs N; A is the balance-beam, provided with steel pivots (multiplication 10 to 1); B is a balance-ball for the balancing the specimen F, which is held in position for testing by the clamps D D; G is a cast-iron standard supporting the beam, which is raised or lowered by screw K and hand-wheel L. A second standard H is provided with a loop J, in which the beam A works; P is a scale-pan for holding shot or sand, and R a spring-balance, which shows the strain on the specimen. S and T represent the mold before and after filling; and U and V the specimen before and after having been tested.

The operation of testing may be thus described: After molding, and set sufficiently for testing, the specimen of cement is placed in the clamps D D. The hand-wheel L is then turned until the beam A rises to near the top of loop J. The scale-pan P should then be fed with fine shot or sand until the specimen breaks, when the index on the dial R will show the strain that was on the specimen when it broke.

This size and style of cement tester is adapted for all the ordinary tests of the tensile strength of cements; but the same manufacturers make larger machines to order, capable of testing up to 1,000 pounds. The machine described is said to be in use for comparing the strength of different brands of cement, by most of the city departments of New York and Boston, by the Brooklyn Bridge Co., the New York Elevated Railroad Co, the United States government, and by numerous engineers and cement users throughout the country. It has the merits of extreme simplicity and compactness, and, like all the products of these makers, is strictly reliable.

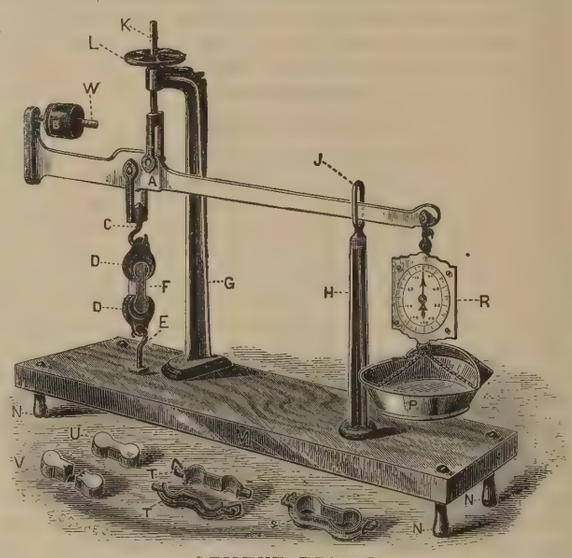
Further information will be given on application to Messrs. Fairbanks & Co., 311 Broadway, New York.

An Electrical Hammer.

The German journals contain descriptions of an ingenious and novel application of electricity lately brought out by Messrs. Siemens & Halske, the well-known Berlin manufacturers of electrical and telegraphic machinery. It is a hammer operated by electricity, and is pronounced to be capable of being applied to a number of useful purposes; amongst others, it is said to be specially applicable to working a rock drill.

The apparatus, as briefly described in the journals, consists of three hollow coils of insulated wire, within which is placed a core or rod of iron, which is free to move up or down within the core, in obedience to the impulse given to it by currents of electricity circulating in the coils. The central coil is traversed by a constant current, which magnetizes the rod or hammer, and the outer and inner coils are traversed by alternating currents from a dynamo-electric machine. The result of the action of these forces on the rod or core, is to cause it to be alternately attracted and repelled, in consequence of which it executes a series of up-and-down movements, imitating the blows of a hammer, whence its name. The movements of the hammer can be made to vary from extreme rapidity to extreme slowness, at will; and the strength of its blows will depend on the strength of the currents by which it is operated.

Many of our readers will recall the ingenious magnetic mallet invented by Dr. Bonwill, of Philadelphia, and which has gained an extensive introduction among dentists all over the country as a substitute for the hand-mallet in plugging teeth. This apparatus is really an electrical hammer, though its construction and action are different from that above described. The Bonwill electrical mallet is actuated by the impact of an armature alternately attracted and freed from contact with an electro-magnet traversed by the interrupted current of a battery. The rapidity of the action of the Bonwill hammer is something marvelous. The inventor, however, so far as we know, has never practically applied his instrument to any uses beyond those of dentistry.



CEMENT TESTER.

In the Siemens & Halske electrical hammer the range of the blow is limited on one side by a spiral spring within an elastic cushion. Whether it will prove to have any practical utility remains to be seen.

Trials of Domestic Motors.

Much attention has of late years been given to the invention and perfection of the details of small motors, suitable for many domestic requirements, and for the needs of numerous small industries and applications where power is only required in limited quantity and at irregular intervals. There are two types of such "domestic" motors—the so-called "gas engines," which are actuated by the combustion of a mixture of combustible gas (or vapor) and air in the cylinder; and the hot-air engines, in which the actuating power is the expansion of a body of heated air. The first class is represented by the well-known engines of Laugen and Otto, and the second by the Rider engine and others.

A trial is reported to have recently been made in Germany to test the relative merits of these several types of small motors. The tests were made with a two horse-power Otto engine, having a cylinder 5.51 inches in diameter, and 11-inch stroke, costing about 3,200 francs, with a Van Rennes 3 horse-power hot-air engine, costing 3,400 francs, and with a 2 horse-power Hock hot-air engine, costing 3,200 francs. The results of these competitive trials, which have been widely commented upon, would appear to establish the practical superiority of the gas engine. The report of the trials is given in what follows.

During the four tests to which the Otto engine was submitted, the consumption of gas was carefully noted and the weight on the lever of the brake was varied. The number of revolutions continued steadily at 180 per minute, and the regulator was so sensitive that when the brake, weighted down with 25 pounds on the lever, was suddenly let go, the motion of the machine was not perceptibly accelerated. It was found that the Otto engine, when developing full power, consumes 35 cubic feet of gas per hour per horse-power, and that the consumption increases considerably as soon as the engine is only working at a part of its power. This is due to the fact that the friction, etc., remains pretty constant, whether the engine is developing its full power or not.

The first trial of the Van Rennes engine lasted three-quarters of an hour. The engine was first making 82 revolutions per minute, with a load of 66 pounds; later the load was 55 pounds, and the number of revolutions 85. The engine developed 3.3 horse-power in the first case, and 2.8 in the latter case. Then it diminished so rapidly that it was determined to make a second trial of greater duration, with a view to ascertaining the consumption of coke at the same time. This trial lasted one hour and three-quarters, the average power developed being 2.2 horse-power, with a speed of 85 revolutions per minute and a consumption of 8.6 pounds of coke per hour per horse-power. In this case, also, the power continued to decrease—a fact which, however, must be attributed to the circumstance that the fire-place and the chimney were such as to prevent a good draft.

During the trials with the Hock motor, no determinations of the consumption of fuel were made. The average of four brake trials yielded 2 horse-power at an average speed of 132 revolutions. The engine ran very irregularly, so that the number of revolutions could only be determined with difficulty. It was necessary to heat or to oil every seven or eight minutes, so that it became evident that it would be impossible to let the engine run by itself.

The cost of fuel is much less for the Van Rennes hot-air engine than for the Otto gas engine; but this advantage is fully compensated by the fact that the latter does not require any fireman. The Hock motor appears to possess very little to commend it.

Hardening Copper.

A San Francisco letter says that Dr. G. S. Mayer claims to have rediscovered the lost art of tempering copper, so that it bears a cutting edge superior to that of steel. Whether this statement is correct or not, its only significance would be in the claim that copper can be made to receive a keener or more enduring cutting edge than cast steel. If this is so, copper implements of some classes may be preferable to those of steel. In no economic point of view, however, would this assured rediscovery of a lost art be of any value. The first cost of a material and its preparation are always important factors in the commercial value of any product, and it is certain that, commercially considered, copper is not so cheap as steel. While without more definite information, there will be doubt of the correctness of Dr. Mayer's claim. It is said that copper razors are in use among Chinese barbers, and that tools of tempered copper are manufactured in one district in the Chinese empire.

A MEDITERRANEAN STEAMSHIP LINE, said to be the first direct line to the ports named below, is reported as about to be established. It is to be known as the New York and Mediterranean Steamship Company, and its vessels are to ply between New York and Gibralter, Marseilles, Geneva, Naples, Sicilian and other Mediterranean ports. Five first-class steamships have been built especially for this service, all of which are said to be provided with excellent accommodations for passengers.

Latest Market Report of Building Materials.

NEW YORK PRICES.

ARTICLES MARKED WITH A STAR (*) ARE QUOTED IN GOLD.

LUMBER.

Pine, very choice and extra dry, per M.	$60 00 a 70 00
Pine, good	55 00 a 60 00
Pine, shipping box	20 00 a 22 00
Pine, common box	17 00 a 18 00
Pine, common box, ⅝	15 00 a 16 00
Pine, tally plank, 1¼, 10 inch, dressed, each	44 a — 50
Pine, tally plank, 1¼, 2d quality	35 a 38
Pine, tally plank, 1¼, culls	28 a 30
Pine, tally boards, dressed, good	28 a 30
Pine, tally boards, dressed, common	25 a 28
Pine, tally boards, culls, dressed	22 a 25
Pine, strip boards, merchantable	16 a 18
Pine, strip boards, clear	22 a 25
Pine, strip plank, dressed, clear	33 a 35
Spruce boards, dressed	22 a 24
Spruce plank, 1¼-inch, dressed	25 a —
Spruce plank, 2 inch,	38 a — 40
Spruce wall strips	14 a — 15
Spruce timber, per M	20 00 a 25 00
Hemlock boards, per M	16 00 a 18 00
Hemlock joist, 2½x4, each	15 a — 16
Hemlock joist, 3x4	16 a — 18
Hemlock joist, 4x6	40 a — 44
Ash, good, per M	50 00 a —
Oak	55 00 a 60 00
Maple culls	25 00 a 30 00
Maple good	45 00 a 50 00
Chestnut	45 00 a 50 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 a 40 00
Black walnut, good to choice	85 00 a 100 00
Black walnut, ⅝-inch	75 00 a 85 00
Black walnut, selected and seasoned	110 00 a 150 00
Black walnut counters, per ft	15 a 20
Cherry, wide, per M	85 00 a 100 00
Cherry, ordinary	60 00 a 80 00
White wood, inch	45 00 a 50 00
White wood, ⅝-inch	30 00 a 35 00
White wood, ⅝ panels	40 00 a 45 00
Shingles, extra sawed pine, 18-inch	4 00 a 5 00
Shingles, clear sawed pine, 16-inch	3 75 a 4 00
Shingles, cypress, 24x6	18 00 a 20 00
Shingles, cypress, 20x6	10 00 a 12 00
Lath, Cargo rate	2 00 a —
Yellow dressed pine flooring	30 00 a 37 50
Yellow pine girders	32 50 a 40 00
Locust posts, 8 feet, per inch	18 a 20
Locust posts, 10 feet	24 a 25
Locust posts, 12 feet	29 a 34
Chestnut posts, per ft	3 a 3½
Basswood per M	25 00 a 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.		Afloat.
Pale, per M.	3 25	a	3 50
Up Rivers	6 75	a	7 00
Jersey	6 00	a	6 75
Long Island	— —	a	— —
Haverstraw Bay	7 00	a	7 12½
" " choice	7 25	a	— —
Favorite Brands	7 75	a	— —
Hollow Fire-Clay Brick	9 00	a	9 25

FRONTS.

Croton—Brown, per M.	10 00 a 11 00
" Dark	11 00 a 12 00
" Red	11 00 a 13 00
Philadelphia	— — a — —
Trenton	21 00 a 22 00
Baltimore	38 00 a — —
Clark's Glens Falls, White	23 00 a — —

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	24 00 a 24 25
" Glengarnock	23 00 a 23 25
" Eglinton	21 00 a 21 50
" American, No. 1	25 00 a 26 00
" American, No. 2	22 00 a 22 25
" American, forge	20 00 a 20 50

	Store prices.		Cash.
Bar, Swedes, ordinary sizes	— 6	a	— 6¼
Bar, Swedes, nail-rod	— 6½	a	— —

LEAD—PER 100 POUNDS.

*German	— — a — —
*English, common	— — a — —
*Spanish	5 75 a — —
*Foreign, refined	— — a — —
*Bar	6 50 a — —
*Sheet	7 50 a — —
*Pipe	— — a — —
*Domestic	4 63 a — —

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 00 a 3 10
8d and 9d, common	3 25 a 3 35
6d and 7d, common	3 50 a 3 60
4d and 5d, common	3 75 a 3 85
3d and 4d, light	4 50 a 4 60
3d, fine	5 25 a 5 35
2d, fine	5 25 a 5 35
Cut spikes, all sizes	3 25 a 3 35
Clinch nails, 1½ to 1¾ inch	5 25 a 5 65
do. 2 to 2¼ inch	5 00 a 5 35
do. 2½ to 2¾ inch	4 75 a 4 85
do. 3 inch and longer	4 50 a 4 60

TIN PLATES.—Duty, 1 1-10 cents per pound.

*I. C. charcoal, 10x14, per box	6 50 a 6 62
*I. C. coke, 10x14	5 00 a 6 00
*I. X. charcoal, 10x14	8 50 a 8 62
*I. C. charcoal, 14x20	6 50 a 6 75
*I. X. charcoal, 14x20	8 50 a 8 75
*I. C. coke, 14x20	5 00 a 6 00
*I. C. coke, terne, 14x20	5 25 a 5 37
*I. C. charcoal, terne, 14x20	5 50 a 5 75

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 7¼ a — 7¾
Sheet, (open)	— 7½ a — 8

SOLDERS.

No. 1	— 12½ a — 13
No. 2	— 11 a — 12

STONE.—Cargo Rates.

Amherst Freestone, in rough, per cubic foot	— 95 a 1 00
Berlin Freestone, in rough	— 75 a — 80
Berea Freestone, in rough	— 75 a 1 00
Brown-Stone, Portland, Conn	1 00 a 1 35
Brown Stone, Belleville, N. J	1 00 a 1 35
Granite, rough	— 60 a 1 25
Canaan Marble	1 25 a 1 50
Dorchester, N.B., Stone, rough, per foot	— — a 1 00

PAINTS.

*Carmine, American, per lb.	gold	6 00 a	6 25
Chalk, per 100 lbs		— 35 a	— —
China Clay, per ton	gold	18 00 a	20 00
Chrome yellow, dry, per pound		— 12½ a	— 28
Lead, red American, per pound		— 6½ a	— 7
Lead, white American, pure, in oil		— 8½ a	— 9
Lead, white American, pure, dry		— 7¾ a	— 8¼
Lead, white English, pure, in oil	gold	— 9½ a	— 10½
Litharge		— 6½ a	— 7
*Ochre, Fr., dry, per 100 lbs		1 50 a	— —
Ochre, ground, in oil, per lb		— 6 a	— 15
Ochre, Vermont, per 100 lbs		— 75 a	1 00
*Orange Mineral, English	gold	— 9½ a	— 10
Paris White, American		— 1½ a	— 1¾
Paris White, English, prime		— 2 a	— 2¼
Paris Green		— 15 a	— 28
Plumbago paint, patent, per lb		— — a	— 25
Putty, per lb		— 2½ a	— 3
Spanish Brown, dry, per lb		— 1⅛ a	— 1¼
Spanish Brown, ground in oil, per lb		— 8 a	— 9
Venetian red, per cwt		1 75 a	2 00
*Vermilion, Chinese, per lb		— 85 a	— 90
*Vermilion, Trieste		— 70 a	— 75
*Vermilion, quicksilver, bags	gold	— 55 a	—57 ½
Vermilion, American, common		— 15 a	— 18
Whiting, per 100 lbs		— 60 a	— 80
Zinc, white American, dry, No. 1		— 5 a	— 7½
Zinc, white American, No. 1, in oil		— 8 a	— 10
*Zinc, white French, dry, (Red Seal,)	gold	— 8¼ a	— 9
Zinc, white French, in oil	gold	— 10 a	— 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 a 4 00
Coach Body	2 35 a 3 50
do do	1 80 a 2 00
Furniture	1 25 a 2 50
Black Asphaltum	1 00 a 1 50
Brown Japan	1 00 a 1 20
Liquid Paint Dryer	1 35 a 1 75
Harness, (black)	3 00 a 4 50
Shellac, Spirits	3 00 a 3 50

CEMENT—PER BARREL.

Portland (imported)	2 65 a 3 00
Portland (American)	2 25 a 2 50
Portland (Spanish)	2 50 a 2 75
Portland (Lafarge)	3 20 a 3 40
Portland (German, Bonner)	2 85 a 3 25
Lime of Teil	2 20 a 2 30
Lime of Teil, per ton	15 00 a 18 00
Roman	2 75 a 3 25
Keene's & Martin's, coarse	6 00 a 6 50
" fine	10 50 a — —
Rosendale	— 90 a 1 00

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb.	— 1¼ a — 1½

HAIR.

Cattle, per bushel of 7 lbs	— 16 a — 18
Goat, " "	— 21 a — 25

SLATE.

Purple roofing slate, per square	$5 00 a 6 00
Green slate	5 50 a 6 00
Red slate	9 50 a 10 00
Black slate, Pennsylvania, (at Jersey City)	3 50 a 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 a — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Nova Scotia, white, per ton	3 50 a 4 00
Nova Scotia, blue	3 50 a 3 75
Calcined, Eastern and city, per bbl	1 25 a — —
Calcined, city casting	1 50 a — —
Calcined, city superfine	1 75 a — —

LIME—PER BARREL.

State, common	— 85 a — 90
" finishing	1 00 a — —
Rockland, common, cargo rate	— 90 a — —
" finishing	1 00 a — —
Ground	— 95 a — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 a — 28
St. Domingo, crotches, fine	— 20 a — 30
St. Domingo, logs, small	— 5 a — 8
St. Domingo, logs, large	— 8½ a — 14
Frontera, Mexican, large	— 9 a — 12½
Frontera, Mexican, small	— 6 a — 8
Other Mexican	— 6 a — 12½
Honduras	— 6 a — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ a — 4½
Rio Janeiro, good to fine	— 5 a — 8
Bahia, ordinary to good	— 2½ a — 4½
Bahia, good to fine	— 5 a — 8
Honduras, per ton	10 00 a 20 00
Satin Wood, per foot	— 15 a — 25
Tulipwood, per lb	— 6 a — 7
Lignumvitæ, large, per ton	25 00 a 50 00
Lignumvitæ, other sizes	10 00 a 20 00

CEDAR.

Cuba, per superficial foot	— 8 a — 11
Mexican, small	— 8 a — 9½
Mexican, large	— 10 a — 11
Florida	— 40 a — 75

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¼ inch.	$ 84	—
2.6 x 6.6	1¼	1 18	—
2.6 x 6.8	1¼	1 24	—
2.8 x 6.8	1¼	1 30	—

DOORS, MOLDED.

Size.	1¼ inches.	1½ inches.	1¾ inches.
2.0 x 6.0	$1 54	—	—
2.6 x 6.6	1 90	2 41	—
2.6 x 6.8	1 96	2 43	—
2.6 x 6.10	1 98	2 51	—
2.6 x 7.0	2 02	2 61	—
3.8 x 6.8	2 02	2 61	3 25
2.8 x 7.0	2 11	2 71	3 35
2.10 x 6.10	2 23	2 82	3 50
2.0 x 7.0	2 33	3 06	3 75

OUTSIDE BLINDS.

Up to 2.10 wide, per lineal foot	25 a —
Up to 3.1 wide	27 a —
Up to 3.4 wide	30 a —

INSIDE BLINDS.

Per lineal foot, 4 folds, pine	56 a — —
Per lineal foot, 4 folds, ash or chestnut	— 90 a — —
Per lineal foot, 4 folds, cherry or butternut	1 07 a — —
Per lineal foot, 4 folds, black walnut	1 30 a — —

WINDOW FRAMES.

Up to 3.4 x 7.2, put together	2 30 a — —

REVIEW OF THE MARKETS.—In the lumber market during the past month business has moved along in a quiet sort of way, and we find nothing of interest to note. The feeling has been cheerful, and the outlook for the winter is quite encouraging. The greater portion of the yards at this writing are well stocked, and additional supplies are to come coastwise during the present month; but the pressure is over, and such amounts as are likely to yet arrive can have no serious influence.

In the brick market cost has been well maintained, and a pretty firm tone has prevailed. Consumption has been good, which, coupled with the increased anxiety on the part of dealers to get in stock, has afforded a steady outlet for supplies.

In the lime market the condition of affairs has not materially changed since our last. Sellers are not likely to lose much advantage at this season, but appear to make no gain, and former rates remain current all around.

In the lath market supplies during the month have been large in some instances, but with an active demand cost has made quite an increase.

In the hardware market orders received have not been large, nor have they come in with any regularity, and the general market has had a dull sort of tone for all kinds of stock, except fancy. Of the latter there has been a little more selling, and especially such as can be considered as coming within the line of holiday goods, with the distribution principally local.

In the paint market demand has been moderate, and the tone dull. This, however, is not out of the usual course at this season of the year, and consequently has not disturbed dealers, either wholesale or retail.

In the metal markets Scotch pig iron has remained steady in tone, a fair control of the supply and favorable accounts from abroad inducing confidence among holders. American pig has been rather slow. Manufactured iron has had a slow sale, and with considerable pressure to realize upon foreign stock, prices have been weak and uncertain for wholesale parcels. Tin in pig has sold fairly in part for consumption, but there is evidence that a number of lots were quietly picked up and brought under control as the basis of a speculative movement. Tin plates have shown some irregularity, both as to movement and price, but as a rule the tendency has been in buyers' favor. Domestic pig lead has met with a moderately active demand as wanted for ordinary trade consumption, but values have lacked firmness. Manufactured lead has been steady.

JAPANESE HAND-SAWS cut on the pull stroke, so that no matter how hard the wood or dull the saw, they will not bend or buckle. It is rather more difficult to saw to line with such saws than with ours, but they have their advantages. Take a key-hole or compass saw, cutting on the push or shove stroke—what an aggravating, awkward thing it is! Now point the teeth the other way, and you have a tool that will keep stiff no matter how many knots it encounters or how dull it gets. In other words, the pull-stroke of 3,000 years ago is the best for thin narrow blades.

Adulterations of Food.

Abstract of a paper read before the meeting of the American Social Science Association, at Saratoga, by Professor S. W. Johnson.

(*Continued from Page 262, November Number.*)

Liebig states in his "Letters on Chemistry," that "the bakers of Belgium discovered twenty (now sixty) years ago how to bake from damaged flour by adding sulphate of copper—a poison—to the dough, a bread in appearance and external properties as fine as from the best wheat flour. Alum has the same effect as sulphate of copper; when added to dough it renders the bread very light, elastic, firm and dry, and the London bakers, in consequence of the demand for white bread, have been compelled to add alum to their flour. I saw (in 1840) in an alum factory in Scotland little mounds of finely ground alum which was destined for the use of London bakers."

To conceal its true nature, the powdered alum used to bear the trade-names "hards" and "stuffs." Hassall not long ago asserted that "alum is used in bread-making nearly all over the United Kingdom." The proportion of alum used in England is said to range from 8 to 12 ounces to the sack of 240 pounds, according to the quality of the flour. These quantities have been sometimes exceeded, it would appear, for not only does the baker put alum with the flour he buys, in order to deceive his customers as to the quality of the bread, but the miller or flour dealer mixes alum into the flour he sells, to deceive the baker.

However happy the effects of alum may be in improving the appearance of the bread and swelling the profits of miller and baker, the effects upon those who are obliged to eat such bread are liable to be most disastrous, if indeed they be not so inevitably. A very little alum in bread may not prove immediately or seriously injurious, but no considerable amount of such a powerful astringent is required to disorder digestion and ruin health, as is shown by a vast array of competent testimony.

The use of alum in bread has not been confined to Europe. Some twenty years ago Dr. Wetherill, of Philadelphia, examined twenty-four samples of bakers' bread of that city, and found alum in two instances. In 1873, Dr. Waller, of the Board of Health of New York, examined fifty-one samples of bakers' bread made in that city, and found six which were probably adulterated with alum and two with alum and sulphate of copper. Last year Dr. Leeds examined a number of bakers' loaves sold in Hoboken, N. J., and in five cases found evidence of alum, which in one sample amounted to 23 grains to the 4-pound loaf. The writer has investigated half a dozen samples of bakers' bread made in New Haven, Conn., without finding either alum or sulphate of copper. It is possible that the comparative immunity from bread adulteration under which we mostly suppose ourselves to be living, is but imaginary, and that falsification is actually practiced and remains unknown because the real facts have not been ascertained by thorough and systematic investigation.

The use of alum for making (out of flour which of itself would give a dark, sticky, sodden bread) a white and flaky loaf, is not a recent invention. In the days of Henry VIII. of England, it was ordained that "his Highness's baker shall not put alum into the bread, or mix rye, oaten or bean flour with the same, and if detected he shall be put in the stocks."

Whether or no alum is mixed by the baker with our daily bread, it is a fact that alum, or its equivalent, is, or recently has been, an ingredient of some of the substitutes for yeast which are so largely employed among us. Yeast itself is a microscopic plant whose growth in wheaten dough generates carbonic acid gas, which inflates or "raises" the loaf. The use of chemicals mixed with the flour that will yield the same gas answers the same purpose, and has the advantage of shortening the time and lessening the labor of preparing bread. The chemicals best adapted in all respects for carbonating dough in the kitchen, are cream of tartar (bitartrate of potash) and soda of saleratus (bicarbonate of soda), and these two salts are the active ingredients of the best "baking powders." But as the supply of cream of tartar is limited, and its cost is considerable, various cheap substitutes have come into use. One of the cheapest that can be employed is alum or the sulphate of alumina, which, mixed with bicarbonate of soda, produces carbonic acid gas abundantly, but contaminates the bread with an injurious or even poisonous substance. In 1878, Dr. H. A. Mott, of New York, stated that the "Patapsco Baking Powder" contained 20 per cent of burnt alum or its equivalent, the "Andrews" 22½ per cent, "Dooley's Standard Baking Powder" 26½ per cent, and "The Charm" 30 per cent. More recently, Dr. Mott asserts that twenty-three brands of baking powder examined by him contained alum or a similar sulphate of alumina.

Before quitting the subject of alum in bread, I ought perhaps to say that the effects of it upon the consumer have been much discussed, and some chemists in Europe, and I believe in this country also, have defended its use. Doubtless people may survive the long continued ingestion of small quantities of alum, as of almost any poison, but the correct principle to adopt in fixing upon a standard of purity in cases of all articles which are understood to be essentially nutritious, is to stigmatize as deleterious adulterations the addition of even the smallest quantities of any substance which has decided poisonous or injurious effects. The recently published experiments of Dr. Mott, made upon dogs, are sufficient demonstration that bread containing alum is a highly dangerous article of diet.

Baking powders are also largely adulterated with terra-alba, which is a trade name for several sorts of white earth, being sometimes ground gypsum (plaster of Paris or sulphate of lime), sometimes carbonate of lime (whiting), and sometimes pipe-clay (kaolin). The cream of tartar and the saleratus sold by grocers are also often grossly weighted by admixture with worthless terra-alba.

If the wheaten flour and the wheaten loaf are thus adulterated, we should expect to find that other cereal foods are similarly falsified. So it has happened in Great Britain, especially in Scotland that oatmeal—which is a standard diet in prisons, work-houses and charitable institutions—is extensively mixed with cheaper barley meal, rice flour, and even Indian meal. Thirty years ago there was a famine in the Scotch Highlands, and some $300,000 was devoted to supplying the needy Highlanders with food. One of the contractors who supplied these unfortunates with oatmeal was suspected of adulterating the article, and was brought to trial. It was shown that the oatmeal was grossly mixed with bran and "thirds" (cheap horse-feed). The offender was convicted and punished, but he brought forward some of the principal millers of Glasgow to swear that the practice was quite common—was, in fact, one of the usages of the trade.

Arrow-root is a variety, or rather includes several varieties, of starch obtained from tropical plants. When genuine, it naturally costs with us more than the starch now made so abundantly from potatoes, and especially from Indian corn. But commonly arrow-root is not genuine, and consists largely or wholly of the cheaper starches of home production. So far as nutritive or medicinal value is concerned, corn starch is doubtless in every sense equal to genuine arrow-root, but it nevertheless is a fraud to sell corn starch under a false name at a fancy price.

Sago and tapioca originally were preparations of starch made in the Indies or Brazil, but now they are perfectly imitated on a large scale from potato and corn starch, and the imitations are every whit as good as the genuine, and being in large demand, are sold at a price that is not unreasonable.

(*To be Continued Next Month.*)

The Anthracite Coal Fields of Pennsylvania occupy but a very diminutive territory as compared with the area of bituminous coal in the United States, or even that of Pennsylvania alone. The anthracite area embraces about 470 square miles, or less than one-20th of the superficial extent of Lake Erie, while our bituminous coal fields cover more than twice the area of our four great lakes combined.

Antimony in Mexico.

One of the most interesting papers read before the late meeting of the American Association for the Advancement of Science, at Boston, and which was only briefly alluded to in the published abstract of the proceedings, was one by Prof. E. T. Cox, late State Geologist of Indiana, on the "Discovery of Oxide of Antimony in Extensive Lodes in the Province of Sonora, Mexico." From the statements of Prof. Cox's paper, to which we have since had access, it appears that much of the antimony of commerce has hitherto been obtained from the reduction of the sulphide, which occurs in considerable quantities in Algeria, Spain, Ceylon and elsewhere, whence it is chiefly exported to England for reduction.

Prof. Cox first called attention to the remarkable deposits of oxide of antimony in the district of Altar, Sonora, Mexico, thirty miles from the Gulf of California, about a year ago; and since that time the mines have passed into the hands of a company of American capitalists, who are now engaged in developing them. From Prof. Cox's description, the lodes in question vary in thickness from 4 to 20 feet, and exploitation carried to the depth of 30 feet, shows that the fissures are filled from wall to wall with the oxide of antimony, almost pure and remarkably uniform in quality. The area over which the ore is found may be roughly stated to be five or six miles long and half a mile or more wide.

In three of the mines now about to be worked by the company above named, we are told by Prof. Cox, the ore stands up boldly above the general surface, and may be traced along the claims for many hundred feet. The ore, so far as explorations have exposed it, is said to be almost pure oxide of antimony, the trifling impurity which it contains being silica. The fire assays show it to contain from 60 to 70 per cent of pure metal, and Prof. Cox estimates the average yield of the lode at 50 per cent. Prof. Sharpless, to whom specimens of the ore were submitted for analysis, has pronounced it to be identical with stibiconite.

The company controlling these remarkable deposits, are actively engaged in developing them, and the ore will shortly be in the hands of the smelters. Prof. Cox concludes that this discovery is destined to produce a marked influence upon the production of metallic antimony, and to greatly extend its uses.

The Library of Congress.

This library contains at present somewhat over 375,000 volumes, and some 120,000 unbound pamphlets, etc. The shelf room of the library is only able to accommodate 280,000 volumes, so that about one-fourth of the collection is practically inaccessible, being piled in heaps upon the floor and in the alcoves, or entirely out of sight. The library comprises over 6,000 bound volumes of newspapers, American and foreign, besides immense numbers of maps and charts, prints, engravings, lithographs, chromos, photographs, and the like. The enactment of the copyright law in 1870, by the provisions of which two copies of each copyrighted publication are required to be deposited in the library, has proved a very wise action, which has greatly increased the library and established a source of constantly increasing annual additions, which in time must make it one of the largest and most valuable collections in the world.

Lion-Breeding.—Some one has undertaken the business of lion-breeding at Bond, in Algeria, in order to supply menageries and zoological gardens with specimens of the king of beasts, for which there is a great and growing demand. The extirpation of the lion in a wild state in Algeria, from a variety of causes, is only a question of a very short time.

Home Department.

Gold's Improved Heaters.

The accompanying illustrations represent the appearance and details of several heaters, embodying, in addition to general excellence of construction as regards material and fitting, certain improved features which add to the healthfulness and economy of this popular species of heating apparatus. The specific objects of the improvements introduced in these heaters, may be briefly stated to be, to provide in their construction so extensive a radiating surface as to insure that they will never become overheated, and that they may always relied on to furnish a continuous and abundant volume of moderately warmed, healthful air. How these desiderata are secured, will appear from the following description, reference being had to the cuts.

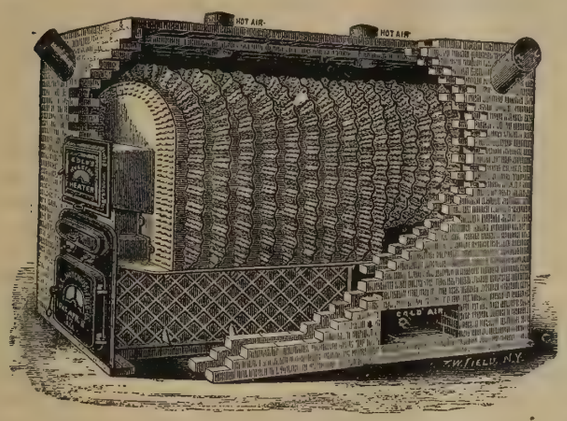


Fig. 1.—"Hygeian" Heater.

Fig. 1 represents the so-called "Hygeian" heater, the masonry being partly removed to show the manner of setting and the form of the radiating surfaces. This heater is made of cast-iron, in sections, having corrugated flanges studded with pins, or points, projecting outward four inches at right angles with the body of the heater. These sections are accurately fitted, and when bolted together, overlap one another two inches. They are so constructed as to be self-packing, and thereby to insure a gas-tight joint under all circumstances. The flanges are corrugated, the space between each being about four inches, and their form, in connection with the pins with which they are studded, provides an extensive area of radiating surface. The ratio of the radiating surface to that of the interior of the heater, it may be added, is about as 12 to 1—a relation which gives excellent security against the possibility of overheating; and this objection is further provided against by the arrangement of the fire-pot in such a manner that no portion of its contents shall come in contact with any portion of the metallic shell.

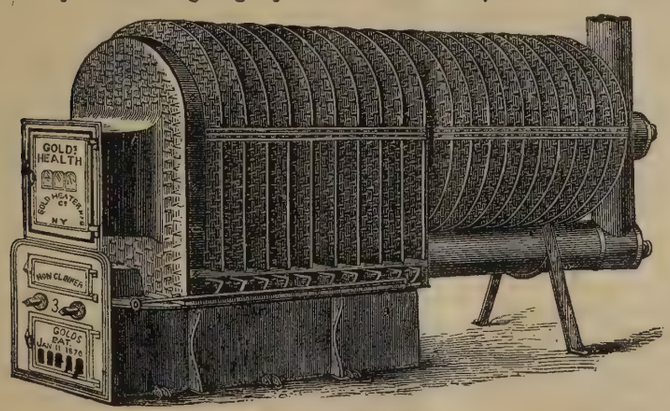


Fig. 2.—"Health" Heater.

The fuel economy of the apparatus is insured by providing a secondary combustion chamber, consisting of a series of circular sections, forming a backward extension of the fire-pot sections, flanged and studded like the others. This attachment insures the more complete combustion of the partially consumed furnace products, and retains the heated combustion products for a longer period in contact with the radiating surfaces, thus insuring a greater economy of heating than is generally secured in single-chamber direct-draft furnaces, in which usually the gases arising from the fuel are passed directly out through the chimney.

Fig. 2 represents the so-called "Health" heater, and Fig. 3 shows the same in longitudinal section. It is constructed on the same general design as the "Hygeian" heater above described, but the body is made of heavy wrought-iron boiler-plate, instead of cast iron. Surrounding this wrought-iron body, both of the fire-pot and the circular secondary combustion chamber, are cast-iron flanges studded with pins, and projecting outward in the same manner and of the same size as those of the "Hygeian," securing thereby the same advantages of a large ratio of radiating to heating surface (12 to 1), that is possessed by the heater first described; and its general design, including the disposition of the fire-pot and the presence of the secondary combustion chamber being the same, the "Health" heater provides quite effectively against the danger of overheating, and effects the same economy in fuel consumption. By reference to the sectional cut (Fig. 3), a special device will be seen, for the purpose of still further economizing the heat of the furnace gases before allowing them to escape through the chimney. This device forms an indirect or return-draft flue in the secondary combustion chamber, and consists of a vertical flue-plate G connecting with the fire-pot, which obliges the furnace gases to pass back and downward, and through the horizontal flue H, before escaping through the smoke flue I. The reference letters on the cut will give a clear explanation of the details of this heater—A is the fire-pot; B, the ash-pit; C, the arch, forming, with the drum D, the shell of the heater; E E, the studded cast-iron flanges; F G H, flue for indirect draft; I, the smoke flue; J, damper to control the direct and indirect draft; L, space for the admission of cold air; and M N, Norcross automatic damper regulator.

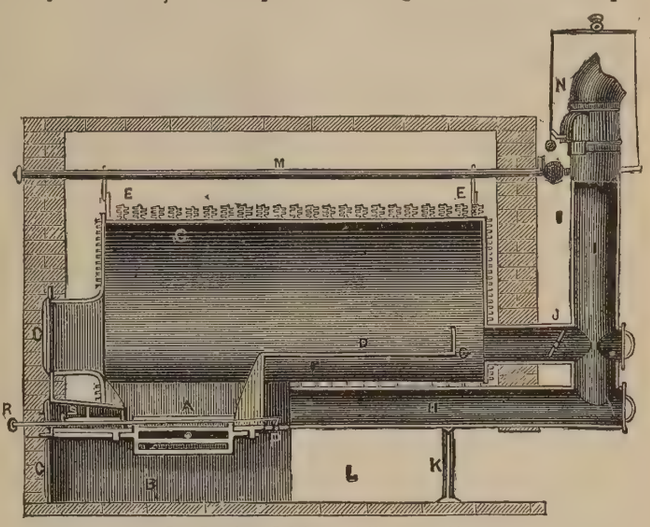


Fig. 3.—Sectional View of "Health" Heater.

Fig. 4. represents a heater of the tubular pattern, and differing materially in form and design from the two above described. It possesses, nevertheless, the same essential features, in providing an extensive surface and guarding against the danger of overheating, that characterize the others. In the cut (Fig. 4), A represents the galvanized iron casing, partly removed, to show the interior construction; B is the wrought-iron cylinder; C is one of a series of wrought-iron tubes surrounding the fire, and through which the cold air to be heated is passed; D is the fire-pot, lined with fire brick; E, the direct-draft smoke-pipes; F, the indirect-draft pipe; G, the check damper and clean-out flue; and M M M, are collars for the attachment of hot-air pipes.

It will be noticed in the above that the "Tubular" is supplied with both direct and indirect draft flues, the first giving facility for kindling a fresh fire quickly, and the last providing for the most economical utilization of the heat, by effecting the distribution of the furnace gases over the entire radiating surface, before they are permitted to escape. This heater is made of heavy material throughout, is compact in form, and strongly put together.

These heaters are made in various sizes, and any additional particulars respecting them can be obtained on application to the Gold Heater Manufacturing Co., 624 to 642 East 14th street, New York.

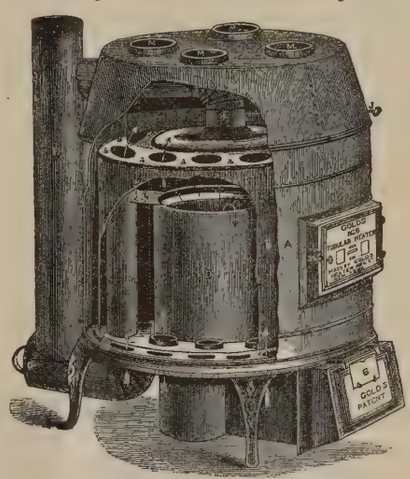


Fig. 4.—"Tubular" Heater.

To Detect Lead in Tinned Vessels.—If a carefully cleansed spot of the lining is touched with a drop of nitric acid, the tin, and lead, if the last named is present, will be oxidized. If the acid is now driven off by gentle heating, and the spot is touched with a drop of a solution of iodide of potassium, the spot will at once turn yellow if lead is present.

Damp Rooms, Damp Beds, Etc.

Damp rooms, as those in brick houses—in which the plastering is placed directly on the walls—are the fruitful sources of many of the acute or inflammatory diseases of our changeable climate. Rooms, also, seldom or never properly ventilated or sunned, in damp localities, and houses the cellars of which are wet for any considerable part of the time, are absolutely unfit for human residences. No families can occupy such houses, living on the north side, and ordinarily escape rheumatism and kindred diseases. It is but little less than suicide to be subjected to such continued dampness. Of course the bedding of such rooms must be not only damp, but to a certain extent moldy, or have a musty odor—almost certain to produce colds and diseases, especially when the "spare bed" is used by those who are so unfortunate as to visit such houses. Such beds are unsafe, if only occupied occasionally, even after having been thoroughly aired and supplied with fresh and

dry blankets. If such localities must be occupied, it is judicious to use bedding that will absorb as little as possible of dampness and foulness—the mattress is superior in this regard to a feather bed—while almost daily airing becomes needful. Dark closets, closed trunks, bandboxes and the like, containing clothing, need to be often aired, allowing sunlight free access. The clothing should be often removed and placed in the direct rays of the sun, and all mold carefully removed. Some free absorbent of moisture, freshly slaked lime, salt and ashes, and the like, will absorb this moisture, which may be promptly removed, at least carrying off much of the dampness. These absorb more readily and more freely than the clothes do, and will obviate a part of the evils of damp houses, and yet nothing can be an adequate substitute for the light of the sun—not even a fire in the room.

New Treatment of Cancer.

The London *Lancet* gives some particulars of investigations at Queen's Hospital, Birmingham, by Dr. John Clay, touching a new method of treating cancer. A study of the pathology of cancer led him to the opinion that a carbo-hydrate of some kind might prove beneficial, and for several reasons he decided that Chian turpentine might prove the most suitable. Dr. Clay reports several cases in which remarkable benefit evidently resulted, with every prospect of permanent cure. The new remedy was administered in pills as follows: Chian turpentine, 6 grains; flowers of sulphur, 4 grains; to be made into two pills, to be taken every four hours. In a case where the turpentine could not be digested in pills, it was made into an emulsion. An ethereal solution of Chian turpentine was prepared by dissolving one ounce of the turpentine in two ounces of pure sulphuric ether (anæsthetic). Of this solution, ½ ounce; solution of tragacanth, 4 ounces; syrup, 1 ounce; flowers of sulphur, 40 grains; water, 16 ounces; 1 ounce three times daily. The maximum dose of the Chian turpentine which can be safely and continuously given is 25 grains daily. It is advisable to discontinue the remedy for a few days after ten or twelve weeks' constant administration, and then to resume it as before.

Commenting on the effects of the new medicine, Dr. Clay says: "The turpentine appears to act upon the periphery of the growth with great vigor, causing the speedy disappearance of what is usually termed the cancerous infiltration, and thereby arresting the further development of the tumor. It produces equally efficient results on the whole mass, seemingly destroying its vitality, but more slowly. It appears to dissolve all the cancer cells, leaving the vessel to become subsequently atrophied, and the firmer structures gradually to gain a comparatively normal condition. It is a most efficient anodyne, causing an entire cessation of pain in a few days, and far more effectually than any sedative that I have ever given. In the cases I have described no sedative was employed in any instance, although in some cases where great pain had existed previously to commencing the treatment, large doses had been given. Whether this arrest of pain arises from the death of the tumor, or is due to there being no longer irritation of the sentient nerves (in consequence of tension being withdrawn by the removal of the cells), the fact is the same."

The Pulse.

Many erroneous impressions prevail about the pulse as indicative of health or disease, a common notion being that its beatings are much more uniform than they really are. Frequency varies with age. In the newborn infant the beatings are from 130 to 140 per minute; in the second year, from 100 to 115; from the seventh to the fourteenth year, from 80 to 90; from the fourteenth to the twenty-first, from 75 to 85; from the twenty-first to the sixtieth year, from 70 to 75. After that period the pulse is generally thought to decline, but medical authorities differ radically on this point, having expressed the most contradictory opinions. Young persons are often found whose pulses are below 60, and there have been many instances of pulses habitually reaching 100, or not exceeding 50, without apparent disease. Sex, especially in adults, influences the pulse, and in women it beats more rapidly than in men. Muscular exertion, even position, materially affects the pulse. Its average frequency in healthy men is, when standing, 81; when sitting, 71; when lying, 66 per minute; in women of the same age and in the same positions, 91, 84 and 79. In sleep the pulse is considerably slower than in wakefulness. In certain diseases, such as acute dropsy, for example, there may be 150, even 200 beats; in other diseases, such as apoplexy and some organic affections of the heart, there may be no more than twenty or thirty per minute. Thus, one of the commonest diagnostic signs is liable to deceive the most experienced practitioner.

How Butter is Made Heavy.

Oleomargarine has hardly come to supply the place of butter, before something is thought of to adulterate oleomargarine. The adulteration takes the shape of soapstone powder which is now used to some extent by the "honest" Western farmers and butter packers. This powdered soapstone is white and fine and tasteless, and is sold as low as $20 a ton. From 6 to 8 pounds of this powdered soapstone can be thoroughly mixed in every tub of butter so as to defy detection. It greatly increases the weight without affecting the bulk very much. This powder is said to be manufactured in large quantities in Cincinnati for legitimate purposes, but it is claimed that a great deal of it is quietly sold directly to dairymen and farmers, and that the adulteration is going on in the churning-room. The buyer who first discovered this new adulteration, says of it:

"I was shown into an adulteration room by a butter-packer. Three dishes were set before me, containing respectively pure butter, powdered soapstone and the butter adulterated with soapstone. I first tasted the pure butter; it was of very good quality. I next tasted the powdered soapstone; it is practically tasteless. I then took a bit of the adulterated butter in my mouth, but could distinguish no difference between it and the pure article. I was then asked to purchase a quantity of the adulterated article, but I declined to do so."

By this process the packers obtain the market price of butter for the soapstone article, which costs them but one cent a pound to adulterate. The consumer is paying for and eats about one-seventh of a pound of soapstone in every pound of butter.

Miscellaneous and Advertising.

A Hartford (Conn.) factory makes 30,000 paper barrels daily.

In consequence of the demise of H. L. Thomson, the business of H. L. Thomson & Co., formerly American agents for Brooks, Shoobridge & Co., the celebrated English manufacturers of Portland cement, is now carried on by the latter firm at the same place—No. 3 Bowling Green, this city.

The enterprising firm of S. C. Forsaith & Co., of Manchester, N. H., offer for sale 1,977 new and second-hand machines, comprising almost every variety. The extensive descriptive price-list published of these machines is a marvel of business energy. This firm have warerooms in this city at 209 Center street.

The enviable, though all deserved, reputation acquired by the Tanite Company, of Stroudsburg, Pa., for their emery wheels and grinding machines, is the legitimate result of excellence in design and workmanship. We call the special attention of manufacturers to the products of this company as being superior in every respect, and capable of giving the very best results.

The Hazard Manufacturing Company's works, at Wilkesbarre, Pa., are running day and night, filling orders from all parts of the world. They are now manufacturing rope in large quantities for parties in Mexico. Mr. Charles Parish is at the head of this establishment. Ground has already been broken for the erection of a building in which to make galvanized wire. This establishment cannot be excelled in the quality of goods manufactured, and will certainly always hold its own.

The simple fact that over 8,000 Leffel water-wheels are in successful operation, is sufficient proof of the high esteem in which they are held by the manufacturing community, and the makers, James Leffel & Co., of Springfield, Ohio, ever on the alert for improvements, and not satisfied with the laurels already earned, are continually adding features to enhance the efficiency of their wheels, which have always given the very highest percentage of useful effect in every trial in which they have entered as competitors.

We learn that J. A. Fay & Co., of Cincinnati, Ohio, manufacturers of wood-working machinery, are overwhelmed with orders, and although their facilities have been largely increased, and they have been running their factory day and night for some time, are unable to keep up with the demand. They are now constructing heavy machinery for a number of large railroads and car-shops. Among them are two outfits for the Union Pacific Railway, the order for which was the largest ever given by any one party for wood-working machinery of one manufacturer. The Pullman Palace Car Co., the Pennsylvania R. R. Co., the Atchison, Topeka and Santa Fe R. R. Co., the Grand Trunk R. R. Co., of Canada, and many others, have recently been furnished with new and improved machinery for manufacturing their cars, from this well-known and enterprising firm.

Design for a Cottage, Costing $1,200.

On the opposite page we present to our readers perspective and floor plans of a very picturesque cottage, designed for families of moderate means who desire to secure an attractive home at small outlay.

The first portion of this cottage is clapboarded, and painted a deep blackish-green, and the upper portion shingled and painted to imitate cedar. The windows are on the French plan—swinging into the room. The upper portion of the windows are stationary and glazed with either small plain or colored glass; but we would advocate the use of colored glass in this portion of the window, as the pleasing effect produced thereby would amply repay the increased expense, which is very little over common glass. The roof, which is slightly curved, is covered with shingles and painted a deep gray, to imitate the color of slate. A neat cresting of red terra-cotta is placed at the ridge of the roof, making a handsome finish. Neat brick chimneys pierce the roof in two places, giving a picturesque outline.

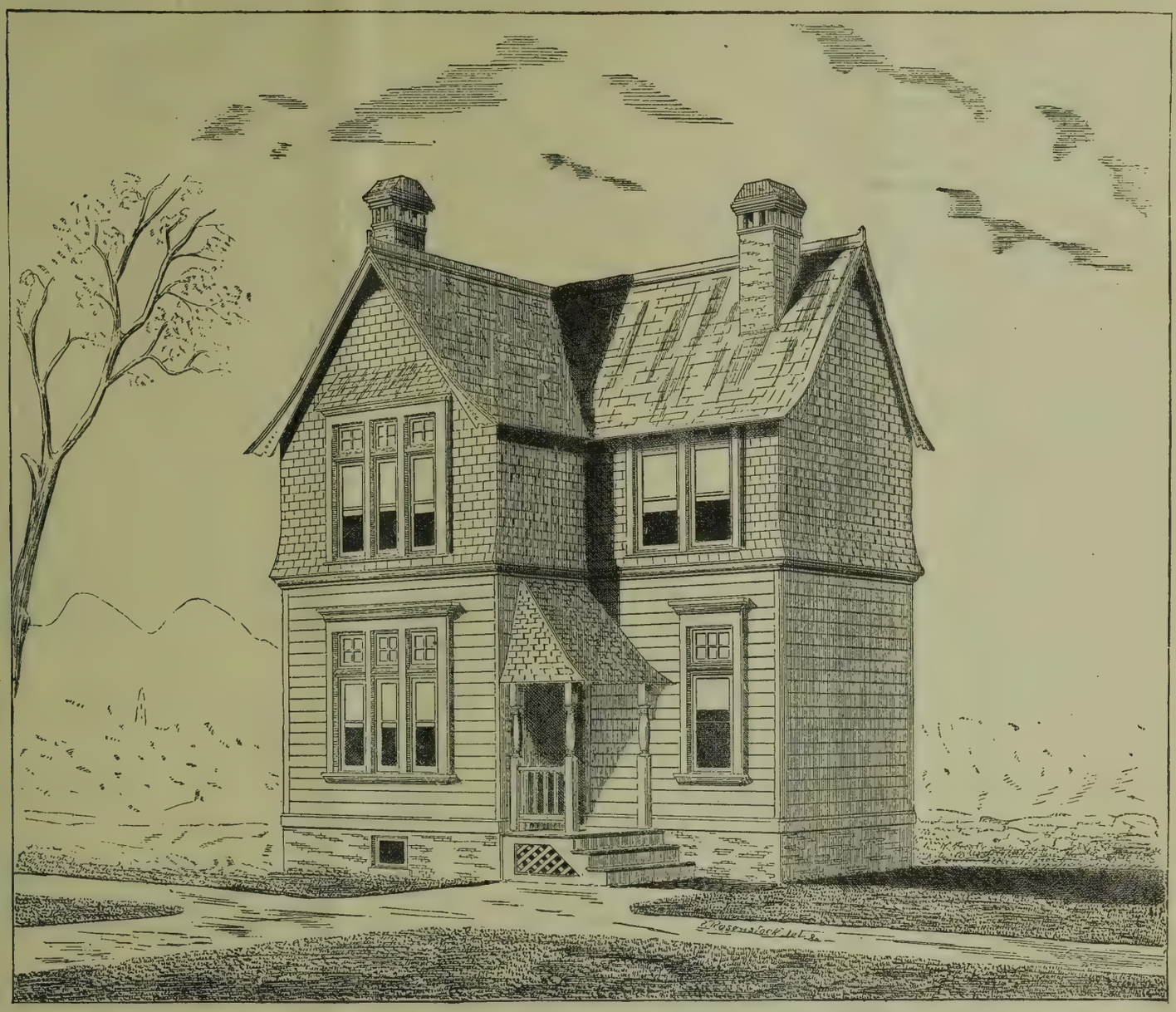
Reference to the ground plan will show that rooms of comfortable size are furnished. The first floor contains a parlor, back of which are two pantries and the stair hall; to the right, the kitchen or living-room, fitted up with a sink, water and china dresser. Access to the stair hall can be had either by way of the kitchen or parlor.

The upper floor contains one small and two large bedrooms, with closet room to each. Neat cornice and center piece to be in the main rooms.

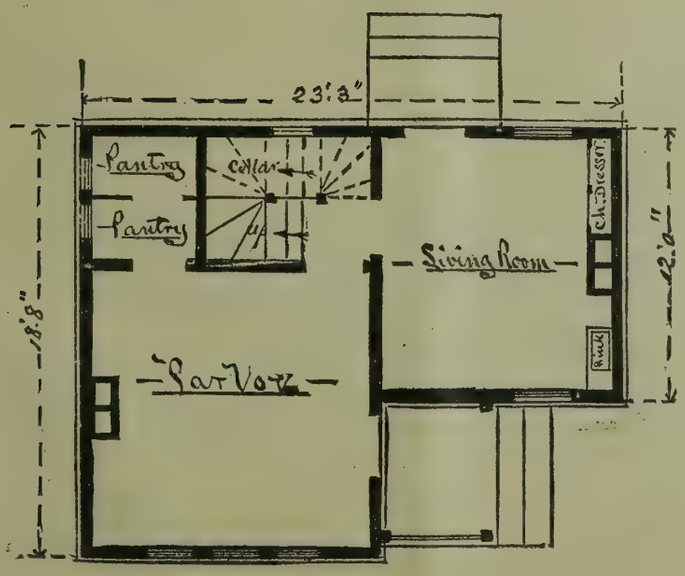
A cellar of the full dimensions of the house is provided. The window-sashes to be painted a deep Indian-red.

This cottage was intended to be erected at Sterling, N. J. The architect is R. Rosenstock, of 215 West 132d street, New York, who will cheerfully furnish any further information desired.

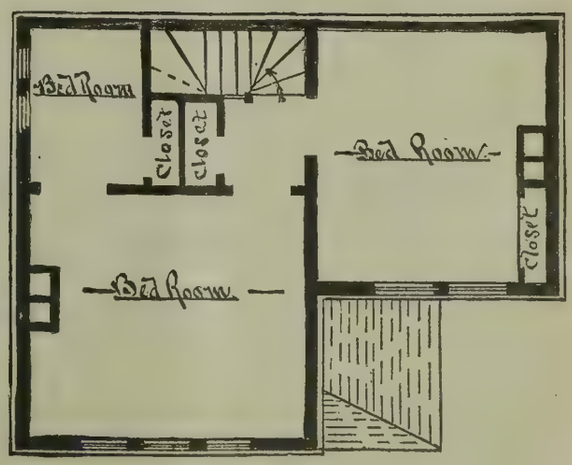
The contractor's estimate for building this house was $1,200, for which sum it can at present be erected in the vicinity of New York city.



DESIGN FOR COTTAGE, COSTING $1,200.



First-Floor Plan.



Second-Floor Plan.

Varnish Making.

The following useful hints are from the *Oil, Paint and Drug Reporter:* In the manufacture of varnish, the first, and one of the most important considerations, is the selection of the gum which forms the base. These gums, known as copal, Zanzibar, Accra, Sierra Leone Manila, Damar and Sandarac, are the resinous juices of trees that grow in various parts of the world. In the condition in which it comes from the tree, it is unfit for use, requiring to be "ripened," and this process is accomplished by nature. The gum, as it exudes from the tree, flows down into the sand, and becoming covered over, remains for many years after—long after the trees have decayed and gone. After being dug from the sands by the natives, it is carefully cleaned with sulphuric acid, roughly selected and exported.

In this country the term "copal" comprehends all the above named varieties wherever found, but the true copal is a product of Africa. The best kind, and that used for the highest grades of varnish, is the Zanzibar gum, which comes from the coast of Africa, between the river Juba and Cape Delgado, opposite the island of Zanzibar, whence it derives its name. A second quality is found on the west coast, and is known under the names of Benguela, Angola, Congo, Loango, Accra and Sierra Leone. The first four are nearly extinct, but there is still a plentiful supply of the last two, which are nearly equal in quality with Zanzibar, and are used for making fine grades of varnish. After coming to this country, the gum is broken up and carefully sorted for the different grades of varnish. It is then ready to be melted. This operation requires the most elaborate apparatus, and the greatest care is taken in order to prevent burning or other injury to the gum. The next step is the preparation of the vehicle by which the gum is to be spread. This ingredient—linseed oil—should be of fine quality and well settled. But before it is fit to be mixed with the melted gum, it must be boiled and bleached and to it added a certain amount of dryers, such as red lead, litharge, and sulphate or borate of manganese, according to the class of varnish to be made, to give the varnish setting properties. When the gum is melted, it is mixed with the oil and then thinned with turpentine. This operation is very dangerous and requires the utmost care to prevent explosions, and to give to the varnish the proper amount of elasticity, body, color, and various other properties which go to make up a first-class article. The more oil contained in the varnish the more durable it will be when put on exposed surfaces—buildings, cars, carriages, etc.; but for indoor work a smaller percentage is required. When the melted gum, the prepared oil and the turpentine have been properly mixed, the mixture is strained and drawn off into tanks in what is known as the settling-room. The temperature of this room is kept at a certain degree all the time, as any change in the condition of the atmosphere would be liable to seriously affect the varnish. The settling process requires from a few weeks to several months, according to the grade of varnish being made, and the mixture is continually subjected to certain tests by an expert handler of the varnish brush, in order that the fineness and purity of the varnish may be decided. The longer varnish is allowed to stand the greater will be its durability, elasticity and covering properties; the color is also vastly improved by age. No matter how much care is taken by the manufacturer, the varnish when completed may have certain properties that are not at all desirable. One of the worst of these peculiarities is that which is known as the "deviltry" of varnish, when it does not dry, or becomes checked or cloudy. In applying the varnish, the least change in the atmosphere will affect it, causing it to become cloudy or "chilled." The brilliancy and clearness may sometimes be restored by the application of a thin coat after the first has become thoroughly dried. In making black baking japan for iron and tinware, the same operations as those above described are gone through with, the only difference being that asphaltum is added to give the black color. Japan dryers are prepared after the same method as the first, with a greater proportion of oil.

Population of Ten of the Western States, from the census of 1870 and 1880:

	1870.	*1880.*
Ohio	2,665,260	3,100,000
Indiana	1,680,637	2,056,500
Illinois	2,539,891	3,125,000
Missouri	1,721,295	2,200,000
Michigan	1,184,059	1,600,000
Wisconsin	1,054,670	1,305,000
Iowa	1,194,020	1,745,000
Minnesota	439,706	776,714
Kansas	364,399	900,000
Nebraska	122,993	452,000

New Publications.

American Health Primers. "School and Industrial Hygiene," by D. F. Lincoln, M.D. Philadelphia: Presley Blakiston. 1880. Price, 50 cents.

This work constitutes the twelfth and concluding volume of the admirable series of "American Health Primers," of which we have given a number of commendatory notices in this department. The present volume is not only fully up to the standard that has made its predecessors to be so highly esteemed as models of popular scientific literature, but the subject is of far more general importance.

Under the head of "School Hygiene," the author discusses, among other important topics germane to his subject, the questions of bodily growth, amount of study, exercise, care of the eyes, school desks and seats, the construction and arrangement of school-rooms, ventilation and heating, site, drainage, etc., and contagious diseases. Under the classification of "Industrial Hygiene," the author treats of the injurious effects of inhaling dusty and poisonous substances, injuries from atmospheric changes, injuries from the over-use of certain organs, injuries from accidents, regulation of hours of labor, and the duration of life in various occupations.

From the nature of the subject, the present volume of the Health Primers will be found to be of more general interest than perhaps any of the others; and in conclusion of our series of notices of these valuable contributions to sanitary science, we take occasion to compliment the editor of the series, Dr. W. W. Keen, to whom we are indebted doubtless for the selection of the themes and their authors, and the publisher for the excellence of the mechanical portion of the work.

Steam Boilers. Their Design, Construction and Management. By William H. Shock, Engineer-in-Chief U. S. N. New York: D. Van Nostrand. 1880. Price, $15.

The limits to which our book notices are necessarily restricted, make it impossible for us to do more than scant justice to a work of the comprehensive and thorough character of this one. It is encyclopædic in its treatment of the subject, and, we may safely add, is decidedly the most complete and masterly work upon the subject of steam boilers, and everything pertaining to them, that has yet appeared. A brief summary of the leading topics presented in the index will serve the purpose of giving our readers an idea of its comprehensive character.

Chapter I. is devoted to introductory remarks upon the materials used in the construction of boilers; the essential parts of a steam boiler and their functions; and the forms of boilers.

Chapter II. treats exhaustively of the important subject of combustion, under thirteen sections: Section 1 treats of the elementary constitutents of fuels; section 2, of the temperatures of ignition; section 3, of the combustion of the constituents of fuels; section 4, of the total heat of combustion; section 5, of fuel as a source of power; section 6, of the conditions essential to perfect combustion; section 7, of the temperature of combustion; section 8, of the volume of the products of combustion; section 9, of the rate of combustion; section 10, of the draught of furnaces; section 11, of chimney draught; section 12, of artificial draught; section 13, of the efficiency of furnaces.

Chapter III. discusses the subjects of the transmission of heat and evaporation, embracing such topics as the laws of the transmission of heat, the transmission of heat in steam boilers, the efficiency of heating surfaces, the loss of efficiency by external radiation and conduction, the influence of the rate of combustion on the efficiency of boilers, superheated steam, and the efficiency of superheating surfaces.

Chapter IV. treats of the materials of steam boilers, embracing the questions of the relative merits and demerits of copper, cast iron, wrought iron, steel and composition for boiler construction, and a presentation of the best ascertained results respecting the tenacity of metals at various temperatures.

Chapter V. treats, under ten subdivisions, of the important subject of the testing of materials used in boiler construction.

Chapter VI. discusses the principles of the strength of boilers.

Chapter VII. treats of the designing of boilers; including therein a discussion of the general considerations governing the design of marine boilers, boiler power, space and weight and spaces required for boilers of a given power, proportion of parts of boilers, relative value of various forms, factor of safety, and drawings and specifications for specific cases.

Chapter VIII. treats of the mechanical operations involved in boiler-making, such as laying-off, shearing and planing, bending, flanging, punching, drilling, riveting, riveted joints, lap joints, butt joints, calking, welding, etc.

Chapter IX. discusses the subjects of shell, furnaces, and back connections.

Chapter X. treats of stays and braces.

Chapter XI. of flues and tubes.

Chapter XII. of up-take, chimney, steam jets, fan blowers, and the general subject of artificial draught.

Chapter XIII. of steam room and superheaters.

Chapters XIV. and XV. describe the modes of setting and erecting boilers, and boiler mountings and attachments, including under the last-named head, grates, furnace doors and frames, valves, pipes, gauges, safety-valves, miscellaneous attachments, boiler coverings, feed-water heaters and filters, feed-pumps and injectors.

Chapter XVI. treats of tests, inspections and trials of boilers.

Chapter XVII. of the management of boilers, discussing specifically the topics of getting up steam, firing, foaming and its causes, incrustation, cleaning, scaling and repairing boilers, and their preservation.

Chapter XVIII. embraces the subjects of the causes and prevention of the deterioration of boilers.

Chapter XIX. the subject of steam boiler explosions.

From this *resume* of the scope of this work, our readers will be able to judge of its comprehensive and exhaustive character. We can specially commend it to all steam engineers and constructors of engines and boilers, as a work embodying the best and most recent information on subjects germane to their profession, and to schools of technology and scientific institutions and libraries, as the most complete work of reference on the subject of steam boilers that has yet appeared in the English language. The work forms a large, handsome quarto volume, illustrated with 36 full-page plates, about 150 wood-cuts, and 400 pages of text. The mechanical execution of the work is in keeping with its importance, and very creditable to the publisher.

Webster's Unabridged Dictionary. Revised Edition. G. & C. Merriam, Springfield, Mass.

Webster's Unabridged is simply undispensable, and forms the corner-stone of every public and private library. This great work, which is a monument more enduring than brass to the learning and industry of its author, has been enlarged and improved by important additions, as new editions were called for from time to time; and the latest revised edition, which we have pleasure in noticing, is of course more valuable than its predecessors. The publishers, fully alive to their responsibilities as the sponsors of the most important educational work in the language, have spared neither care nor expense to make it as perfect as possible; and when we say that we could better spare all the books from our shelves than Webster's Unabridged, we know that we simply echo the opinion of all who have it; and to the few who have not, we would say we know of no better investment.

Modern Architectural Designs and Details. Part II. Bicknell & Comstock, 194 Broadway, New York. 1880. (Plates). Price, $1.

Since the announcement in our last of the intended publication of this useful contribution to architectural literature, the publishers have issued two parts of the contemplated work. Our opinion of the value of the work, based on an inspection of sample sheets of the plates, has been fully justified. Part II., now before us, contains eight lithographic plates, including a store front, with designs for counters, details of show-window, designs for brackets, designs for gates and fences, designs for window caps and hoods, designs, sections and details of balconies, and a number of elevations and plans of low-priced cottages, costing from $500 to $1,500. We can commend the publication to the attention of architects and builders.

OTHER PUBLICATIONS RECEIVED.

Annual Reports of the Chief of Engineers, United States Army. 1880.

Prospectus. The Technical Schools of the Metropolitan Museum of Art of the City of New York. 1880.

The Story of a Live School. Packard's Business College. New York: S. S. Packard.

First Catalogue of the American Society of Mechanical Engineers. Organized April 7th, 1880. Officers, Members and Rules. September, 1880.

Census Bulletins: No. 12, New York State in part; No. 13, New York City complete. Department of the Interior, Census Office, Washington, D. C.

Engineer Department, U. S. Army. Hollow Brick; Solution of Equations and Interpolation in Series; Foundations; and Arches in Masonry Bridges. Washington: Government Printing Office. 1880.

Department of Agriculture. Special Report, No. 26. Report on the Culture of Sumac in Sicily, and its preparation for Market in Europe and the United States. Prepared by Wm McMurtrie, Ph.D. Washington: Government Print. 1880. From the Department.

Summary Statement of the Imports and Exports of the United States, for the month ended July 31, 1880, and for the seven

months ended the same, compared with the corresponding periods of 1879. Prepared and published by the United States Bureau of Statistics. [Corrected to September 15th, 1880].

The Thirty-Seventh Annual Report of the New York Association for Improving the Condition of the Poor, for the year 1880, with the list of members and contributors; and Rules, Acts of Legislature and Incorporation. Organized 1843; incorporated 1848. New York: Office of the Association, 79 Fourth Avenue, between 10th and 11th streets. 1880.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of scientific or practical knowledge falling within the field of The Manufacturer and Builder. *All persons possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2719) Origin of Petroleum Oil.—Please give an explanation of how petroleum was formed.—L. M. B., Buffalo, N. Y.

(2720) Why a Belt Runs to the Highest Part of a Pulley.—Will you give an explanation in your valuable answers to correspondents, as to why a belt will always run to the highest part of a pulley.—J. B. S., Akron, O.

(2721) Converting Motion into Heat.—Is there any practicable method known by which to convert motion, or power, into heat? For instance, can the power of a windmill be used to produce steam? Have there been any attempts in this direction?—J. S. D., Vail, Ia.

(2722) Silvering by Cold Rubbing.—Please give me a recipe for silvering by rubbing.—S. C. R., Roxborough, Pa.

(2723) Air Compressor.—What size air cylinder would I require to hold enough compressed air to run a one-10th horse-power engine for one hour?—that is, to do the work of a man for one hour?—J. B., Georgetown, D. C.

(2724) Asbestos Roofing.—Can you inform me whether the asbestos roofing is durable or not? I have been told that it will not last over two years. What can you say for it? If it is good, you will do the company justice to give the public a statement of its durability; if not, I suppose you not hesitate to tell what it is.—W. W., Pilot Point, Tex.

(2725) Are Paper Collars Poisonous?—I have seen occasional articles in the papers asserting that arsenic was used in the paper of which paper collars are made. Is this statement true?—S. R. C., Savannah, Ga.

(2726) Incrustation on Brick Walls.—Seeing your answer to the query of "Bricklayer" as to the best manner of removing black mortar and rain stains from brick fronts, I would like to be informed on a similar subject. In the winter and early spring, we are greatly troubled here in Philadelphia by an ugly white coating that covers our brick fronts and makes them look very unsightly. It makes its appearance generally right after a spell of damp or stormy weather. I wish you could explain what causes it, and how it can be prevented, if possible.—B. F. M., Philadelphia.

(2727) Misuse of a Symbol.—I write to ask what is the strict scientific application of the symbol ″, and whether there is any authority for using it to designate inches?—P. F. B., Des Moines, Ia.

(2728) Retreat of the Flame of a Bunsen Burner.—Is there any way of preventing the jumping back or descent of the flame of a Bunsen burner?—J. V. W., Johnstown, Pa.

(2729) The Sand Blast.—I have contended, Mr. Editor, that the "sand blast" was an American invention, but this has been denied by several persons with whom I have had an argument, and we have agreed to refer the matter to your decision. A reply through the columns of your journal will oblige.—C. R., Meriden, Conn.

(2730) Cobalt Plating.—Please inform me if plating with cobalt has been tried. If so, with what success?—O. W., Washington, D. C.

(2731) Chemical Questions.—1. Will you kindly inform me what are the principal soluble lead salts. 2. By what cheap and simple process can I convert borax into carbonate of soda, so as to reclaim the boracic acid? The boracic acid should be free. I have all the back volumes of the Manufacturer and Builder, and find them invaluable, but can find nothing to help me in this.—A. V., Belleville, Ont.

(2732) Removing India Ink Marks.—Would you be so kind as to inform me how to remove India ink marks from the skin, that have been pricked in.—A Ten Years' Subscriber, New York City.

(2733) Water Motor.—By giving a description of the Chandler & Silver water motor, with sectional cuts, in your journal you will greatly oblige an old subscriber.—M. S. H., Hoboken, N. J.

(2734) Toughened Glass.—Having seen articles published by you at different times in regard to the manufacture and uses of tempered glass, I would like to obtain, if possible, the address of those who manufacture it.—J. V. B., Yankton, D. T.

(2735) Benzine in a Gas Machine.—How will benzine work in a gas machine?—F. W. B., Tiffin, O.

(2736) To Remove Indelible Ink Marks.—Is there any way of removing indelible ink markings from linen?—M. B. J., Oswego, N. Y.

(2737) Blast Furnaces and Rolling-Mills.—Where can I get a list of the blast furnaces and rolling-mills in the United States, with the names of owners, size, capacity, production, etc.?—J. D. McD., Toronto, Canada.

(2738) Number of Pounds a Man can Strike.—Please inform me how many pounds on an average a man can strike with his fist.—J. B., Georgetown, D. C.

REPLIES.

(2719) Origin of Petroleum Oil.—The manner of the formation of the deposits of mineral oil that occur so abundantly in this and other countries, is still involved in some doubt. The only statement that may safely be made concerning it, is that it is a product of the decomposition of animal or vegetable matter of former geological epochs. Some regard it as the product of the decomposition of land or marine plants; others, that it has been produced by the decomposition of animal matter; others again, that it is a species of coral oil, not formed by the bodies of the coral polyps, but secreted by corals, principally of the Devonian age; others, that it is distilled from bituminous shales by subterranean heat, the shales being made up of the mud of lakes and estuaries that were once largely filled with vegetable and animal débris. Other authorities again, think that the true solution of the problem is not to look to one source only for the origin of petroleum. Dr. Lawrence Smith, for example, in discussing this subject, asserts that there can be no doubt that the primal sources of petroleum were both vegetable and animal; that the Pennsylvania and Virginia petroleums were derived almost exclusively from vegetable decomposition; and that those of Canada, and of Kentucky and Illinois, were derived principally from animal matter. How the transformation of animal or vegetable matter into petroleum was effected, we do not know, further than that temperature and pressure were important factors in the operation. Prof. Peckham supposes that petroleum is the normal or primary product of the decomposition of animal or vegetable organism—chiefly the former—and that nearly all other varieties of bitumen are products of a subsequent decomposition of petroleum. Prof. Lesquereux attributes its origin to the partial decomposition of low forms of marine vegetation. The first named savant again affirms his conviction that the remains of animal life have contributed much more largely to the formation of petroleum than has generally been supposed; and further, that the different varieties of petroleum are largely due to the varied forms of animal life existing during the different geological epochs to which the rocks belong from which oil primarily issues. Dr. Sterry Hunt, a high authority, entertains similar opinions. He holds that the presence of the petroleum oils of Pennsylvania and Canada in the lower palæozoic rocks, which contain no traces of land plants, shows that they have not in all cases been derived from terrestrial vegetation, but may have been formed from marine plants or animals. The latter view, he adds, is not surprising when we consider that a considerable portion of the tissues of the lower marine animals is destitute of nitrogen, and very similar in chemical constitution to the woody fiber of plants. These abstracts of the opinions of eminent authorities will suffice to show our inquirer that there is still considerable uncertainty as to the exact method by which petroleum has been formed. While some differences exist, however, in respect to the *modus operandi* of its formation, he will nevertheless observe that all these authorities are agreed that petroleum is a product of the decomposition of organisms that have lived in early geological epochs. Beyond this fact, nothing has yet been determined with certainty. It may be added, in conclusion, that M. Berthelot, a distinguished French chemist, has presented an ingenious hypothesis in which he attempts to show that petroleum may have had a purely mineral origin; but his argument, though plausible, has found no supporters.

(2720) Why a Belt Runs to the Highest Part of a Pulley.—The most reasonable explanation of this circumstance that we have seen, is that which is formulated by Mr. J. H. Cooper in his "Use of Belting," as follows: "The edge of the belt which is towards the larger end of the cone, is more rapidly drawn than the outer edge; in consequence of this, the advancing part of the belt is thrown in the direction of the larger part of the cone, which obliquity of advance toward the cone must lead the belt on its highest part." It has been urged in objection to this explanation, that it does not account for the fact that a round belt, which has no "leading edge," behaves just like a flat one, and that it does not explain why a belt stops climbing so soon as its center reaches the higher part of the cone. It is argued that this lead should continue until the entire belt—the entire width—had reached the higher part, and that then a reflex action should take place, as the other edge of the belt would then be subjected to the lead, so that the belt should be in perpetual oscillation from side to side. Those who urge these objections to the foregoing explanation, hold that centrifugal force is a sufficient and simple explanation of the creeping of a belt. In reply to the objections just presented, Mr. Cooper answers that it must be obvious that that part of a belt nearer the highest part of a rounded pulley must be more rapidly drawn, because the circumference of the pulley is greater, and this affects a round belt in the same way, because such a belt is *not round* in action, but oval, with a flat face against the pulley; and this flat face, however narrow, is subject to the same unequal drawing force of the pulley. This explanation does not necessitate that such a belt should be in "perpetual oscillation," Mr. Cooper urges, since the advancing edge *pushes back* after it passes the summit, with a gradually increasing force, until half the width is over, when the belt is in equilibrium, and quietly remains there. Centrifugal force doubtless has some influence on belts running at high revolutions, but it may safely be omitted as a factor in the explanation of the creeping of a belt, because it is a fact that a belt will surely go to the high part of a pulley, even if its velocity is invisible, or no greater than clock wheels; and it must therefore be assumed by the advocates of the centrifugal force theory, that if the centrifugal force at such speeds would be equal to the task of pushing heavy belts up the incline of pulleys, it must be equivalent to the force required for pushing the same belt over the straight face of a pulley. We think, from a perusal of the above, our correspondent will agree with us that Mr. Cooper's explanation of the creeping of a belt is the correct one.

(2721) Converting Motion into Heat.—As this correspondent is doubtless aware, wherever motion is arrested, whether by friction, compression, percussion, etc., heat is produced, and the quantity of heat generated is exactly the equivalent of the motion that has disappeared, the phenomenon being simply the conversion of one form of motion (mass motion) into another form (molecular motion), and demonstrating the convertibility and indestructibility of force. The idea advanced by our inquirer, however, of employing mechanical means for the generation of heat for useful purposes, is impracticable, by reason partly of the difficulty that would be encountered in gathering up the heat and applying it without loss, and chiefly because the generation of heat by chemical action (combustion) affords us an infinitely more serviceable method of obtaining heat for domestic and industrial uses. The power of a windmill could readily be made to produce sufficient heat to generate steam, by the interposition of suitable frictional surfaces, so disposed as to convey the heat as fast as produced, to a body of water. Count Rumford's celebrated experiment of causing water to boil by the friction of a solid plunger fitting closely into an iron cylinder surrounded with water, is an analogous case; and many other experimental methods of producing similar conversion of motion into heat might be named. But the notion of utilizing these methods, as this query reads, is not worthy of serious consideration, in view of the measureless floods of heat that we can summon to do our bidding by the simple act of combustion. The only case we recall on the instant where the heat generated by the arrest of motion is directly utilized, is in the so-called "fusion disk" of Mr. Reese, of Pittsburgh, Pa. He employs a large disk of steel revolving at enormous velocity, to cut rails, girders, and other manufactured forms of iron and steel to lengths. This device is reported to perform its work with marvelous rapidity, and its operation is claimed to depend, not on abrasion, but on the actual fusion of the metal from the impact of the particles of air which the rapidly revolving disk hurls against it. If this explanation is the correct one, the revolving disk does not touch the metal it cuts through. This correspondent will find the subject of the production of heat by mechanical processes elucidated in a very interesting manner in Tyndall's admirable treatise on "Heat as a Mode of Motion," and in "The Correlation and Conservation of Forces," a series of expositions by Profs. Grove, Helmholtz, Mayer, Faraday, and other distinguished investigators, to which we refer him for further study of the subject.

(2722) Silvering by Cold Rubbing.—The following formula for silvering by cold rubbing has been highly recommended: Make a paste by thoroughly grinding in a porcelain mortar, out of the light, chloride of silver, 7 ounces; potassium oxalate, 10½ ounces; common salt, 15 ounces; sal ammoniac, 3¾ ounces; water, 3 to 5 ounces. Or, chloride of silver, 3½ ounces; cream of tartar, 7 ounces; common salt, 10½ ounces; water sufficient to form a paste. Keep in a covered vessel away from the light. Apply with a cork or brush to the clean metallic (copper) surface, and allow the paste to dry. When rinsed in cold water, the silver presents a fine frosted appearance, the brightness of which may be increased by a few seconds' immersion in diluted sulphuric acid, or a solution of potassium cyanide. The silvering bears the action of the wire brush and of the burnishing tool very well, and may also be "oxidized." Should a first silvering not be found sufficiently durable after scratch-brushing, a second or third coat may be applied. This silvering is not so adherent or so white on copper as on a gilt surface. For the reflectors of lanterns, the paste is rubbed upon the reflectors with a fine linen pad; then with another rag a thin paste of Spanish white or similar substance, is spread over the reflectors and left to dry. Rubbing with a fine, clean linen rag restores the luster and whiteness of the silvered surface. The paste is sometimes mixed directly with the whiting and left to dry, or until nearly dry, then rubbed down as described.

(2723) Air Compressor.—As the question is put, the data are not sufficient to enable a proper answer to be given. The horse-power named (one-10th) would demand

$$\frac{33{,}000 \times 60}{10} = 198{,}000 \text{ foot-pounds of work}$$

to be stored up in the air reservoir. The volume of air required for the storage of this amount of work would depend on the pressure and temperature of the air in the reservoir, and on the pressure to which the air was wire-drawn into the motor. If we assumed the air in the reservoir to be at a pressure of

100 pounds per square inch above the atmosphere, and the motor to be worked with 50 pounds to the square inch, it would require about 600 cubic feet of air to do the work. But this estimate will depend upon the temperature of the air and radiation of heat from the reservoir and pipes.

(2724) Asbestos Roofing.—So far as we know, we incline to a favorable opinion of asbestos roofing. The manufacturers of this species of roofing claim that it forms a smooth, water and air tight surface, which is a good non-conductor of heat, and is practically a resistant of fire; that it is adapted to all climates, and is not surpassed in durability and cheapness by tin, slate or shingles. We do not know of any facts to call these claims into question, and certainly would not hesitate to say so if we knew the material to be worthless. From what we know of the nature of asbestos, we feel fully warranted in recommending its use for roofing purposes, and the favorable testimony of those who have given it a trial confirm this view.

(2725) Are Paper Collars Poisonous?—Such statements have occasionally been made, but so far as we know they lack confirmation. Arsenic compounds are not infrequently used in colored wall-papers, as the cheapest and brightest greens are arsenic colors. But we can see no object in using arsenic in the preparation of the white paper for collars. If the object were to weight the paper, there are many substances that would answer the purpose better, and which are far cheaper; or, if for the purpose of giving luster or finish, there could be nothing so good for the purpose or so cheap as starch and starch mixtures. We cannot conceive, therefore, of any reason for using this poisonous substance, since it can serve no useful purpose that could not be better served by the use of harmless and cheaper substances.

(2726) Incrustation on Brick Walls.—This question is one of special interest to the editor, as, being himself a Philadelphian, he has had his attention called to the disfigurement of brick walls named by B. F. M., very frequently. The cause of this disfigurement is well known, and it might easily be corrected, as it rests entirely with the bricklayers and builders to do it, as will appear from the following explanations. The trouble complained of by B. F. M. is to be ascribed almost exclusively to the use of magnesian lime for the mortar which is exclusively employed for building purposes in and about Philadelphia. This magnesia contained in the mortar is acted upon by the sulphuric acid which is the ultimate product of the combustion of sulphur in coal, and is therefore formed in immense quantities from the combustion products thrown out from the countless chimneys of the city. The rain and mist, which are most abundant during the winter and early spring, dissolve this sulphuric acid, the more or less porous bricks absorb it, the magnesia of the mortar is by it converted to the condition of sulphate of magnesia. As the brick-work gradually dries out, this sulphate of magnesia finds its way through the bricks by capillary attraction, and as the moisture gradually evaporates from their surfaces, it is left behind, forming the unsightly white efflorescence so trying to the patience of Philadelphia housekeepers. It has been suggested that this nuisance might be caused by the decomposition of magnesia-silicate contained in the brick clay, from the action of the sulphur in the coal used in the kilns; but the percentage of magnesia contained in the brick clay is so small—seldom, if ever, exceeding one-half of one per cent—that the amount of magnesia sulphate that could be formed from it, would be too infinitessimal to account for the quantity and persistence of the efflorescence. There is no doubt that we have a sufficient explanation of its occurrence in the character of the mortar. An analysis is given below of the composition of a sample of Philadelphia lime used for building purposes, which will show this to be the case. It contained, in 100 parts,

Lime	57.18	per cent.
Magnesia	37.38	"
Silica	1.19	"
Iron and Alumina	1.03	"
Sulphuric acid (trace), carbonic acid, manganese, alkalies and water	3.22	"
	100	

It is generally held that a magnesian lime is lean—that is, that it will only slake slowly and with great difficulty, and that on this account it is unfit for building purposes. This statement will be found in most of the chemical text-books and works of reference. This assertion must be regarded as a mistake, for the magnesian lime slakes readily, forms a gelatinous mass very absorptive of water, and permits of the addition of large amounts of sand. It is true that it is slower in setting, but on this very account it is a favorite with the Philadelphia bricklayers, because it enables them to spead their mortar and lay a long reach of brick at one operation, while the quick-setting properties of pure lime mortar will only allow of laying two or three bricks at a time. The Philadelphia bricklayers, accustomed to the use of this slow-setting mortar, which enables them to get through with much more work than with the use of a pure lime, will use no other—they actually refuse to use a pure lime mortar, and pronounce it unfit to use. The universal use of magnesian mortar, therefore, is responsible for the aggravated form in which the nuisance of the efflorescence on brick walls shows itself in the above named city. That this is the case, and that the above explanation is the correct one, is additionally proved by the fact that in other localities where pure lime mortars are used, the nuisance is unknown. In Pittsburg, for instance, the only lime available is that from the limestone of the coal measures, containing only two or three per cent of magnesia; or from the "Sinking Valley," Tyrone, or other places near the eastern foot of the Allegheny Mountains, all of which is notably free from magnesia, the percentage of this element rarely exceeding 6 per cent, and being often less than 1 per cent. The bricklayers accustomed to it know no other, and use it with entire satisfaction; and in spite of the enormous consumption of coal in that city and its immediate neighborhood, no incrustation occurs there. We should add in conclusion of this very interesting subject, that the unsightliness of this incrustation on brick walls is not the only objectionable thing about it, for it is the indication of a more serious evil, namely, the disintegration of the mortar uniting the bricks, causing the destruction or fall of the chimneys, and the washing out of the joints, particularly in the back walls or gable ends of houses, where the bricks are irregular in size and the joints consequently thicker. The cavities and open joints thus produced, facilitate destruction, until the retained moisture penetrates the wall and compels the owner to refill or re-point the joints at heavy cost—an operation that in all probability will require to be repeated after a few years.

(2727) Misuse of a Symbol.—There is no difference of opinion, so far as we know, that the only legitimate signification of the symbol ″, is to designate *seconds of arc;* but custom has given a certain sanction to the use of the same symbol to designate inches. This double use of the same symbol is not to be recommended, for although there is not much risk that these diverse significations will be mistaken for each other, as the context will prevent such mistakes, it is not desirable that the same term or symbol should be used indiscriminately in scientific papers, with two entirely different meanings; and though custom has come to sanction the ″ symbol to designate inches in engineering works and specifications, it should be discountenanced on general principles, and the symbol should be restricted to its only legitimate use, which, as above stated, is to designate seconds of arc. But the misuse of this symbol goes still further than this, since it is even used to designate *seconds of time* as well. It is apparent that such misuse of the symbol can readily give rise to ambiguity and errors. For example, let us say that a certain observatory is situated 24″ W. of Washington. The correct interpretation would make the location 1.6 seconds of time west of that meridian, whereas, as a matter of fact, the intention of the person using the symbol was to indicate that it was 24 seconds of time west of that meridian. Such misuse of the ″ symbol, as we have indicated, appears in numberless papers printed in our scientific journals, and has before now called forth protests against it. One of these protests which we recall, was made by Capt. William Noble, an English astronomer, to the Royal Astronomical Society; but unless some concerted action is taken by the leading scientific bodies, by the exclusion of such misapplications from the pages of their journals, private protests will avail but little to correct them. To show how absurd the misapplication of the symbol ″ can be made, let us take the case of a 4″ lens, meaning, of course, a lens having a focal length of 4 inches. We would be justified, from the indiscriminate use of the symbol, in affirming that the lens in question subtended an angle of 4 seconds of arc, and that the observatory above referred to was 24 inches west of Washington. The misuse of the ″ symbol is very glaring, and certainly should be corrected.

(2728) Retreat of the Flame of a Bunsen Burner.—The retreat or descent of the flame of a Bunsen burner, which is something of an annoyance, can be prevented in a tolerably effectual manner by slightly contracting the outlet of the burner; or, instead of this, by simply inserting a strip of thin steel or copper, say of about a finger's breadth and two or three inches long, and rolled up, into the upper orifice of the burner-tube, where it will remain in place in consequence of its elasticity. The retreat of the flame is due to the fact that the mixture of gas and air does not escape from the burner opening with the same velocity in all its parts. The outer portions of the escaping mixture are more or less retarded by friction against the walls of the tube, and have consequently less velocity than the central portions. This state of things produces a more or less irregular combustion, a flickering of the flame, and where there is a weak gas pressure, a tendency of the flame to burn down the tube; hence a Bunsen burner with an ill proportioned or roughly constructed tube, will give an unsteady flame, and when the gas pressure is reduced by turning off the supply, as in lowering the flame, the flame retreats with a jump to the base of the burner. By narrowing the opening of the combustion tube, or by introducing the metal coil as recommended above, the retreat of the flame is prevented, because the peripheral portions of the gas and air are held back and prevented from escaping, and only the central portions of the gas current escape, all parts of which have practically the same velocity. Our correspondent will find, by making the trial, that either of the suggestions made above will effectually correct the trouble he wishes to prevent.

(2729) The Sand Blast.—The use of a jet of sand for cutting and abrading hard substances, was discovered and patented by Mr. Benjamin C. Tilghman, of Philadelphia. The invention was patented in the United States, and in numerous European countries, about the beginning of the year 1871. You are therefore right in maintaining that the invention is of American origin. By somewhat of a coincidence, we may add that the first presentation of this interesting and valuable invention, was made by the editor of this journal, who first publicly announced the invention, and exhibited samples of work done by the sand blast, at the monthly meeting of the Franklin Institute, held February 15th, 1871, and the first published account of the sand blast will be found in the *Journal of the Franklin Institute*, for March, 1871, of which the writer was at that time the editor.

(2730) Cobalt Plating.—Plating with cobalt can be performed by using the same procedure as with nickel, simply substituting cobalt salts in place of nickel. It has been done frequently by way of experiment, and successfully. Cobalt plating, in fact, is superior even to that of nickel in point of beauty of finish, hardness and durability. The only reason why it has not been generally introduced, is doubtless the high price of cobalt compounds as compared with those of nickel, and until this objection is removed the introduction of cobalt plating will be impossible. We have not the time to spare to make search through the patent records to ascertain if there are any patents for cobalt plating. This O. W. must do for himself. But we scarcely think that there would be any patents for a procedure that is too expensive to be generally used.

(2731) Chemical Questions.—1. The principal soluble lead salts are the nitrate and the acetate. The first named salt is soluble in 7½ times its weight of cold, and in much less hot water. Of the acetate, 1 part by weight is soluble in about 2 parts of water. 2. There is no "cheap and simple process of converting borax into carbonate of soda, so as to reclaim the boracic acid." The fact that borax costs considerably more than soda, is sufficient proof of this fact. The conversion of borax into carbonate of soda can be effected, and the boracic acid liberated, if there were any object to be gained in so doing, by the following indirect process: Dissolve borax at 212° in 4 times its weight of water, and add a quantity of concentrated sulphuric acid (oil of vitriol), equal to one-fourth the weight of the borax. The sulphuric acid unites with the soda and forms sulphate of soda, which continues in solution, while the boracic acid separates in thin, shining crystalline plates on cooling. These crystals may be drained off, and being sparingly soluble, may be washed with cold water, and subsequently re-dissolved in boiling water, and made to crystallize again to obtain the boracic acid pure. The sulphate of soda resulting from this decomposition may be converted into the carbonate—or the soda of commerce—by the well-known process of Leblanc, by mixing with an equal weight of ground chalk and half its weight of fine coal, and heating to fusion in a reverberatory furnace. This is the best method we can suggest by which the conditions of the question propounded by our correspondent may be fulfilled—namely, that carbonate of soda and free boracic acid shall be obtained from borax. The economy of the process is highly problematical and will depend entirely on the cost of the borax. At present prices, the operation would not pay, as soda is made very cheaply from common salt by the Leblanc process; and as we do not know of any industrial uses for free boracic acid, we can see no economic advantage in preparing boracic acid by the decomposition of borax.

(2732) Removing India Ink Marks.—There is no method known of removing India ink markings that have been pricked into the skin, save by the same slow and painful process in which they were at first introduced. The coloring matter in this case is carbonaceous, and hence insoluble. The superficial application of any remedy to remove it will therefore be utterly useless. The only method that will prove efficacious, is the painful and tedious one of pricking the skin as was done when the markings were made, and squeezing out the solid particles of coloring matter with the blood. If this is done carefully and thoroughly, the marks may be removed; but in no other way can it be done, except by excision—that is, by actually cutting out the marked piece of skin.

(2733) Water Motor.—We send this inquirer a pamphlet containing the information which he requests us to publish. If this is not satisfactory, we will endeavor to give him further information respecting any points on which he may still desire to be enlightened.

(2734) Toughened Glass.—We send this inquirer (by letter) the address of a leading house engaged in the manufacture of toughened glass, with whom he may correspond; and some additional information by letter.

(2735) Benzine in a Gas Machine.—The commercial product called benzine, is not volatile enough to work satisfactorily in a gas machine. Gasoline is commonly used for the purpose.

(2736) To Remove Indelible Ink Marks.—The so-called "indelible" inks are generally prepared from salts of silver, and the writing or marking done with them may be removed by soaking the parts with a solution of cyanide of potassium, or of hyposulphite of soda; or by moistening with a solution of cupric chloride, and then washing with aqua ammonia. It should be remembered by M. B. J. that the cyanide of potassium is highly poisonous, and must therefore be used carefully.

(2737) Blast Furnaces and Rolling-Mills.—The American Iron and Steel Association has published, within the last year or two, a "Directory of the Iron Works of the United States." This contains precisely the information our correspondent asks for. It is, moreover, full and detailed, and the information it gives is strictly reliable and authoritative, as may be inferred from the source from which it emanates. The compilation is made by Mr. James M. Swank, Secretary of the American Iron and Steel Association, who is the proper person to address with reference to securing a copy. His address is No. 265 South Fourth street, Philadelphia, Pa.

(2738) Number of Pounds a Man can Strike.—We should think about 200 pounds.